



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

In Search of New Worlds
Navigator Program

Public Engagement Plan

August 2003

*To understand and protect our home planet
To explore the universe and search for life
To inspire the next generation of explorers
...as only NASA can.*

The NASA Mission

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**Jet Propulsion Laboratory
California Institute of Technology**

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EXECUTIVE SUMMARY

A Core Element of NASA's Future

Navigator Program missions represent a voyage of unprecedented scope and ambition, promising insight into humankind's most timeless questions: *Where did we come from? Are we alone?* These missions, charged with the goal of finding and characterizing planets like Earth in orbit around stars other than the Sun, will contribute greatly to NASA's commitment to push the boundaries of space exploration beyond our solar system. Such bold missions call for an equally far-reaching and innovative public engagement program. Navigator's public engagement initiatives will invite the public to share in this adventure, and invite students to see clearly how they might take an active part in this exciting journey.

1. **Navigator Missions: A Generation-Long Effort:** The Navigator program currently consists of four ground-breaking NASA missions that span a twenty-five year time horizon. Two space-based and two ground-based missions will contribute to the overall goal of detecting and characterizing Earth-like planets around stars other than the Sun. The Keck Interferometer began its science mission in 2002, and the Large Binocular Telescope Interferometer will become operational in 2006, while the two space-based missions, SIM and TPF, will launch in 2009 and 2015, respectively. The science operations and analysis of all missions will be supported by the Michelson Science Center, operated by the California Institute of Technology. The extended mission time horizon allows public engagement initiatives to evolve and change with the long-term goals of the program. However, the time horizon also suggests the need to develop and implement innovative and viable short-term platforms for education and outreach.
2. **Navigator Program Science Objectives:** The Navigator Program is an element of the Astronomical Search for Origins and Planetary Systems theme of the Office of Space Science. Navigator Public Engagement will incorporate the science objectives from the 2001 Navigator Program Plan into its initiatives:

Science Objective 1: To learn how galaxies, stars, and planets form

Science Objective 2: To look for signs of life in other planetary systems

3. **Education and Public Outreach Science Threads:** The Navigator E/PO program will be anchored to a few succinct science threads that resonate within the education community and are clearly tied to national science education standards. Navigator Public Engagement has chosen to focus its program science objectives on the following questions: *how do scientists acquire knowledge about the physical world? How do we gather information about objects we cannot see, touch, or directly manipulate, like Earth-like planets in far-away solar systems?* Navigator Public Engagement will pay special attention to the following two threads:

Science Thread 1: the diversity of worlds

Science Thread 2: what we can learn from light

4. **NASA Education and Public Engagement Goals:** The 2003 NASA Strategic Plan presents a clear set of goals and objectives related to education and public engagement. These goals follow directly from NASA's mission "to inspire the next generation of Explorers." The specific goals relevant to Education and Public Outreach activities sponsored by NASA's Office of Space Science include the following:

NASA Strategic Goal 6: Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

NASA Strategic Goal 7: Engage the public in shaping and sharing the experience of exploration and discovery.

5. **E/PO Plan Construction: A Program-Level Plan:** Though the Navigator Program contains four individual ground and space-based missions, the Navigator E/PO Plan is based upon one set of unified education and outreach initiatives. These initiatives incorporate the individual science objectives and project milestones of each mission, but maintain a unified approach to communicating the Navigator story at the program level. This coherent approach allows for more synergies and for the development of a more substantive set of initiatives and activities as it provides the opportunity for Public Engagement to build upon a set of common threads and goals.
6. **Public Engagement Programs:** Navigator Public Engagement initiatives fall into three key programmatic areas: formal education, informal education, and public outreach (including Internet and media). Additionally, several crosscutting activities support various components of the plan. All Navigator activities are important to the success of the program, however, two initiatives (the *Community College Initiative*, and the *Night Sky Network: Engaging Amateur Astronomy Clubs*) stand out as significant new investments for Navigator and may serve as platforms for the participation of other NASA missions in the future. Following are brief descriptions of each of Navigator's Public Engagement programs:

Formal Education Initiatives:

Community College Initiative: Over half of all astronomy instruction in the U.S. takes place in community colleges. Navigator's goal is to reach and impact more than a third of the nation's 1200 community colleges within a three-year period. The core of Navigator's impact will be achieved through the involvement of a national Educator Advisory Board and a series of lecture/tutorials focused on: 1) techniques in astronomy, 2) tools and telescopes, and 3) the nature of light. The program will be rolled out through a series of "teaching excellence" workshops that will be enhanced by large national conferences devoted to improving the teaching Astronomy 101 survey courses. A related initiative involves the

expansion of a successful California research program for community college students known as the Consortium for Undergraduate Research Experiences. A modest Navigator investment supported a winning NSF grant for \$500,000 which will allow 70 students to be mentored by scientists and others over the next four years.

Navigator Research Experiences for Minorities: Navigator is investing in a three-year pilot program that has two components: 1) an 8-week summer research program based at the University of Tennessee designed to expose undergraduate math, science and engineering students to advanced science research while exposing them to NASA career opportunities, and 2) the development of an online astronomy course intended to enhance space science education within the Historically Black College and Universities, Hispanic Serving Institutions, and Tribal College communities. Both the research opportunities and the online course will be systematically expanded over time through the addition of other partners' institutions and the solicitation of outside funding.

Informal Education Initiatives:

The Night Sky Network: Engaging Amateur Astronomy Clubs: Working with the Astronomical Society of the Pacific (ASP), Navigator is creating a national "Night Sky Network," linking hundreds of amateur astronomy clubs around the country through fun and educational demonstration activities (a PlanetQuest Kit), a dedicated website, training, compelling visuals, and newsletters. These amateur clubs will have an estimated reach of 100,000 to 200,000 people per year.

Girls in Science (Girl Scouts): Navigator has partnered with the Solar System Education Forum to provide training, activities, resources, and mentoring to Girl Scouts and their leadership groups. The Girl Scouts of the USA represents more than 2.6 million girls, parents, leaders, and councils.

Solar System Ambassadors: The Solar System Ambassadors Program mobilizes nearly 300 volunteers across the nation to hold events geared to the public and informal education communities. Navigator Public Engagement has trained and provided presentation materials to dozens of ambassadors who will be able to reach tens of thousands of individuals around the country each year.

Museums, Exhibits and Alliances: Navigator E/PO is supporting the Space Science Institute's development of a traveling three-year-long exhibition on the search for cosmic origins. The interactive exhibit will be organized around three interrelated areas: *Star Birth*; *PlanetQuest*; and *Search for Life: Are We Alone?* Navigator E/PO also developed a permanent PlanetQuest kiosk at The Keck Visitors Center at Mauna Kea allowing visitors to take a "virtual tour" of the Keck Interferometer (the center receives about 100,000 visitors per year). Navigator will create materials and sponsor events to tie-in to the 2004 broadcast of the PBS

ORIGINS series. Plans are also in the works for the development of a planetarium show called: *The Search for Another Earth*.

Public Outreach Initiatives:

Internet Initiatives: Navigator’s award-winning PlanetQuest website serves as a virtual portal for Americans to join in the search for new worlds. It offers content of unprecedented richness and depth, and provides opportunities for the public to learn and participate through interactive visuals, animations, and virtual reality simulations. The dynamic, ever-changing content reflects the rapid pace of discovery in the field of extrasolar planet observation. The website has had traffic growth averaging 20% per month since its launch in January 2002.

Media Support Initiatives: Media support initiatives will keep pace with changes inherent in the long-term evolution of the Navigator education and outreach program. Navigator E/PO works closely with the NASA and JPL media relations office to support science and mission results and announcements. Visualizations, distribution of popular articles and stories, and documentary filming will serve to enhance press materials and media possibilities.

Crosscutting Initiatives:

Participation of Scientists and Engineers: Navigator Public Engagement has established a “science team E/PO fund” that will invest in new public engagement opportunities developed by scientists in their regions. E/PO support also includes enhanced presentation and communications support of scientists and engineers, involving PIs in product review, and engaging PIs and others to participate in formal and informal education initiatives and public outreach as well as coordination with the MSC science outreach team.

Management and Communication: Effective management and communication includes oversight, communications, plans, reviews, budgets, and reports to JPL management, project teams, scientists and NASA. To supplement overall communication, Navigator publishes a bi-monthly email newsletter called “Navigator E/PO Headlines” to a list of over 400 names, including NASA officials, JPL education and outreach personnel, mission personnel, industry partners, and E/PO partners.

Visualizations and Animations: Visualizations created to support the emerging story of the “search for another Earth” are particularly important for “sharing the experience of discovery” and “engaging the public” in the search for another Earth. Navigator mission launches are far off, and they will not result in stunning “public-friendly” visuals. But the ability to capture the imagination is great in this quest to answer one of the oldest questions. Vivid animations, compelling videos, and intriguing interactives (such as the 3-D Universe) can all play a vital role.

Input and Evaluation Navigator has retained outside evaluators to assess the quality, effectiveness, and expected outcomes of all of its initiatives. These evaluation efforts are being undertaken at the overall program level, and are also contained within individual programs. Navigator will invest 8% to 10% of its resources in evaluation and in developing feedback processes. Assessing ways to engage the education and outreach communities more effectively is central to Navigator's evaluation efforts.

7. **Navigator Public Engagement Budget:** In the second quarter of FY2003, all four individual Navigator mission EPO budgets were rolled-up into a single program-level budget in order to facilitate improvements in budget planning and management, and to support the ongoing development of program-level initiatives.

Current funding for the Navigator E/PO Program of \$1.4 million for FY 2003 will increase to \$1.8 million in FY 2004, hitting a high of \$2.9 million in FY 2008. The total dedicated Navigator E/PO budget for the next six years is \$13.5 million. The Navigator budget is in compliance with OSS guidelines of 1% to 2% of total mission spending. Creating a solid and meaningful framework for education and outreach programs in the short term is critical to Navigator's ability to take best advantage of financial resources which expand as missions near their anticipated launches over the next several years.

FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008
\$1.4M	\$1.8M	\$2.0M	\$2.5M	\$2.8M	\$2.9M

8. **Public Engagement Management and Workforce:** The Navigator E/PO effort is managed by W. Michael Greene in the JPL Office of Communication and Education. The Navigator E/PO team is currently comprised of four experienced staff members, and receives strong support from JPL specialists in formal education, media relations, and film and video production, and financial analysis. The team receives additional support at the program level from the Outreach Scientist, Rolf Danner.

INTRODUCTION

Born of the extraordinary accomplishments of 20th century physics, astronomy, geology, and biology, the Origins program takes up the challenge of answering questions as old as our species.

Alan Dressler, 2003 Origins Roadmap

A Core Element of NASA's Future: Navigator Program missions represent a voyage of unprecedented scope and ambition, promising insight into humankind's most timeless questions: *Where did we come from? Are we alone?* These missions—The Keck Interferometer, the Space Interferometry Mission, the Terrestrial Planet Finder, and the Large Binocular Telescope Interferometer—together with the Michelson Science Center are charged with the goal of finding and characterizing planets like Earth in orbit around stars other than the Sun. These missions will contribute greatly to NASA's commitment to push the boundaries of space exploration beyond our solar system.

Such bold missions call for an equally far-reaching and innovative public engagement program that will utilize unique teaching tools and compelling learning experiences, a program that will invite the public to take part in the journey, and invite students to imagine how they might take part in this exciting endeavor.

The far-reaching Navigator Program offers a glimpse of a new and evolving base of knowledge and experiences that will be incorporated into educational materials, curriculum, training, and into new and innovative public venues. These experiences will also be leveraged to provide opportunities for postsecondary students to have authentic involvement in mission development activities.

Navigator Missions

The Navigator missions are a part of NASA's Origins Theme, which includes more than a dozen ground and space-based missions seeking answers to the fundamental questions about the origins of galaxies, stars, planets, and life. Some missions, such as Kepler, directly complement Navigator science goals related to the search for another Earth, while other missions such as SIRTf, FUSE, and the Hubble Space Telescope share the Navigator Program's goal of contributing to the understanding of the formation of galaxies and stars.

The Navigator Program currently consists of four ground-breaking NASA missions. Two space-based and two ground-based missions will contribute to the overall goal of detecting and characterizing Earth-like planets around stars other than the Sun. These will be the most sensitive instruments ever built, capable of extending planetary research beyond the bounds of our own solar system.

The Navigator Program consists of the following missions and centers:

- **The Keck Interferometer** will combine the light of the world's largest optical telescopes, extending our vision by a quantum leap. Using a technique known as interferometry, Keck will study dust clouds around stars where planets may be forming. It may also provide the first direct images of giant planets outside our solar system.
- **The Space Interferometry Mission (SIM)**, scheduled to launch in 2009, will measure the distances and positions of stars several hundred times more accurately than any previous observations. SIM's precision will allow us to determine the distances to stars throughout the galaxy and to detect evidence of planets just slightly larger than Earth.
- **Terrestrial Planet Finder (TPF)**, anticipated for launch in 2015, will be capable of detecting and characterizing Earth-like planets around as many as 200 stars up to 45 light years away. The project will look for the atmospheric signatures (such as water, carbon dioxide, and ozone) of habitable or even inhabited planets.
- **The Large Binocular Telescope Interferometer (LBTI)** consists of two 8-meter class telescopes on Mount Graham, Arizona will be linked to create an infrared interferometer capable of imaging giant planets and other faint objects over a wide field-of-view.
- **The Michelson Science Center** Support for all of Navigator missions is provided by the Michelson Science Center (MSC), a science operations and analysis service operated by the California Institute of Technology. The MSC facilitates timely and successful execution of projects that use interferometry, a key technology in the Origins Program.

A Generation-Long Effort

The Navigator missions span a twenty-five year time horizon. The Keck Interferometer began its science mission in 2002 and the Large Binocular Telescope Interferometer will become operational in 2005, while the two space-based missions, SIM and TPF, will launch in 2009 and 2015 respectively. Navigator missions are organized to successively attain more demanding levels of science objectives, and demonstrate more advanced technical capabilities. Each mission will build upon the prior mission's technological and science results in order to enable the discovery and characterization of terrestrial planets.

This extended time horizon for Navigator missions allows public engagement initiatives to evolve with the long-term goals of the program. Navigator Public Engagement recognizes the need to invest in programs that will ultimately succeed because of careful development and implementation. The ability to accept the infusion of new ideas is critical to the ultimate success of the E/PO effort as is the desire to create a flexible framework for engagement capable of adapting and changing to new demands and directions. The absence of mission launches in the short term creates a challenge and

requires that Navigator Public Engagement invest in the development and implementation of innovative and viable short-term platforms—or events—for public engagement as well as invest in visualizations in order to continue to engage the imaginations of students, educators, and the public.

Navigator Program Science Objectives

The Navigator Program is an element of the Astronomical Search for Origins and Planetary Systems theme of the Office of Space Science. Navigator Public Engagement will incorporate the science objectives from the 2001 Navigator Program Plan into its initiatives:

- **Science Objective 1: To learn how galaxies, stars, and planets form**

During the past three decades, we have used both ground- and space-based facilities to look inside the environments where stars and planets are born. Parallel studies conducted in the solar system with planetary probes and studies of meteorites have revealed clues to the processes that shaped the early evolution of our own planetary system. An overarching goal of science in the 21st century will be to compare what we observe elsewhere in the universe with objects and phenomena in our own solar system.

Stars began to form even before the first galaxies formed, and what had been a calm, near-formless sea began to surge with the froth of complex forms of matter and energetic processes. Today the universe is full of structure, from the giant but simple galaxy to a minuscule but complex single living cell. Our objective is to understand how this came about, how stars and planets form, how the chemical elements are made, and ultimately how life originates.

By allowing us to see more clearly into our own galaxy, NASA's Navigator missions will give us observations of the formation of planetary systems and help us characterize their properties. We will be able to determine how the evolution and life cycle of stars influence the chemical composition of material available for making stars, planets, and living organisms.

- **Science Objective 2: To look for signs of life in other planetary systems**

Less than ten years ago, we had not observed any planets around other stars. Today, over one-hundred planets and planetary systems have been detected using ground observatories. However, most of the planets discovered so far are gaseous giants like Jupiter, and are unlikely to harbor life. The big questions remain to be answered: *Are there Earth-like planets? What are their characteristics? Could they support life?*

Earth-like worlds might also orbit other stars, but at this point our measurements are not precise enough to detect a world as small as Earth. Keck, SIM, Kepler, and TPF will take us on the journey of finding smaller and smaller planets, and of seeing them more precisely. NASA's flagship mission, the Terrestrial Planet Finder, will carry forward the search for Earth-like worlds by imaging nearby

planetary systems and separating out the extremely faint light of a terrestrial planet from its parent star. This is important because these small planets must orbit closer to the glare of the parent star for life-giving liquid water to exist.

The final piece to this puzzle will be determining if these planets actually have conditions suitable for life, and to see whether any of these planets show signs of past or present life. Just what are the “biosignatures” – the life markers identified in the spectrum of a planet’s light – that can be seen in the new Earth-like planets? TPF will be able to make progress towards this goal, but new telescopes may also be needed.

Science Threads for Education and Public Outreach

The Navigator Program science objectives clearly frame the scientific and technical achievements required to attain mission milestones. However, the need to translate the Navigator mission science objectives into clear “science education threads” is critical. The K-12 education community (including informal education venues such as science museums and planetaria) can more effectively adopt these activities if they address and meet existing teaching and education standards.

Acknowledging the importance of “science as inquiry,” Navigator Public Engagement has chosen to focus its program science objectives into the following questions: *How do scientists acquire knowledge about the physical world? How do we gather information about distant objects, especially those we cannot see, touch, or directly manipulate, such as Earth-like planets in far-away solar systems? And how does what we know about our own solar system give us clues for what to look for?*

To address the question about how scientists acquire knowledge about the physical world, Navigator E/PO will focus on two science threads: 1) the diversity of worlds, and 2) what light can tell us.

1. Science Thread 1: The diversity of worlds

This includes the questions of how life arose in our solar system, and the related question of what conditions are required for life. How do scientists approach these questions? How do the Navigator missions take us closer to answering them? Sixth graders might be asked to think about why water might have existed on Mars. Why don’t we expect to find terrestrial life on Jupiter? What are the most extreme environments in which life can flourish? How do these conditions relate to the 100 planets we have found outside of our solar system so far? If you were to “imagine a new world,” what elements would you need to make it suitable for life? What are the tools, techniques, and theories that we use to investigate and discuss the diversity of worlds?

2. Science Thread 2: What we can learn from light

For distant planets, Navigator missions analyze the emitted and reflected light of the parent star, and of the new planet to create a coherent “story” of the past and present of these planets. How can we learn about what far-away planets might contain solely from the light reflected from their surface? What are some of the tools we might use to investigate these mysteries? How do telescopes work, and how do they help us answer these questions? How does the spectral fingerprint of a planet’s atmosphere help solve the mystery of whether it might harbor life? For the fifth-grader, what does a rainbow tell us about light waves? How does the temperature of an object affect its color? If ice is cold, why is it blue? How can we tell the size and temperature of a star from its color? What does the light from the Sun tell us about the Sun? What happens to light when it passes through different materials? What should a pre-service teacher think about while taking an astronomy course that might be fascinating for their future second or seventh-graders?

NASA Education and Public Engagement Goals

The 2003 NASA Strategic Plan presents a clear set of goals and objectives related to education and public engagement. While Navigator acknowledges the fact that the formulation of the underlying objectives are evolving, the basic goals follow directly from NASA’s mission “to inspire the next generation of Explorers.” The specific goals relevant to Education and Public Outreach activities sponsored by NASA’s Office of Space Science as stated in the last published Strategic Plan include the following:

NASA Strategic Goal 6: Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

Objectives:

6.1 Improve student proficiency in science, technology, engineering, and mathematics by creating a culture of achievement, using educational programs, products, and services based on NASA’s unique missions, discoveries, and innovations.

6.2 Motivate K-16+ students from diverse communities to pursue science and math courses and, ultimately degrees in science, technology, engineering, and mathematics.

6.3 Enhance science, technology, engineering and mathematics instruction with unique teaching tools and experiences that only NASA can provide, that are compelling to educators and students.

6.4 Improve higher education capacity to provide for NASA's and the Nation's future science and technology workforce requirements.

NASA Strategic Goal 7: Engage the public in shaping and sharing the experience of exploration and discovery.

Objectives:

7.1 Improve the capacity of science centers, museums, and other institutions, through the development of partnerships, to translate and deliver engaging NASA content.

7.2 Improve science literacy by engaging the public in NASA missions and discoveries, and their benefits, through such avenues as public programs, community outreach, mass media, and the Internet.

The importance of demonstrating capabilities and assets unique to NASA becomes increasingly critical as NASA undergoes renewed internal evaluation of its priorities and obligations with regard to education and workforce pipeline issues. NASA's mission "to inspire the next generation of NASA explorers as only NASA can" forms the primary prism through which programs will be evaluated. Navigator Public Engagement initiatives will result in real opportunities for students, teachers, and the public to participate in the story and adventure of the "search for another Earth." The specific ways in which Navigator Public Engagement activities and programs support these NASA strategic goals and objectives is detailed in the body of this plan.

Core Values

In addition to supporting NASA's goals and objectives, Navigator Public Engagement embraces the following six core values that will be sought in all initiatives:

1. **Enhancing the Involvement of Scientists and Engineers** – Approximately 400 scientists and engineers participate in Navigator missions at NASA. Their involvement, and that of others such as the Michelson Fellows, is crucial to the goal of carrying the story of Navigator science to the education and general public communities.
2. **Linking to the Formal Education Community** – Consulting and engaging education professionals and organizations in all aspects of programmatic and curricular development from the beginning is critical to the development of an effective set of initiatives. Working to understand the perspective of the audience, and establishing the "case for need" is an often over-looked step in many new and existing programs. Navigator Public Engagement will seek to expand the involvement of education specialists in all areas of its initiatives and work to engage this audience from the very beginning.

3. **Reaching Underrepresented Audiences** – Current population trends suggest that underrepresented audiences will become a majority of the US population over the next generation. The engagement of African American, Hispanic, Native American, and other under-represented audiences is a key value of Navigator E/PO as well as a critical workforce pipeline issue for NASA.
4. **Leveraging the NASA OSS Education Support Network** – NASA’s Office of Space Science has developed an extensive network of Forums and Broker/Facilitators well-positioned to extend the reach of Navigator E/PO efforts. Though Navigator is a part of the Origins Education Forum (which includes more than a dozen missions addressing various aspects of the astronomical search for origins (Hubble, Kepler, SIRTf, and others), partnerships and coordination with other OSS Forums (including the Solar System Exploration Forum, Structure and Evolution of the Universe Forum, and the Sun-Earth Connection Forum) are becoming increasingly important for Navigator. The OSS Broker/Facilitator network provides an opportunity to expand the program reach further as brokers become agents for regional events and initiatives.
5. **Creating Effective and Flexible Partnerships** – Ultimately, the key to reaching a wide number of people will be Navigator’s ability to leverage and multiply limited E/PO resources. The extended time-frame of the Navigator Program missions creates an ideal opportunity for Navigator E/PO initiatives to develop, evolve, adjust, and grow with meaningful partnerships. These partnerships can provide the expertise and the means to reach larger audiences. The rapidly changing landscape in formal and informal education also requires that programs be flexible and scalable. The ability to research, test, evaluate, and make changes in programs will be critical to the success of Navigator Public Engagement. Currently, Navigator EPO is developing partnerships that will impact amateur astronomy clubs, community colleges, middle school-age girls, and minority university students, among other communities.
6. **Incorporating Meaningful Evaluation and Mechanisms for Change** – Clear and measurable benchmarks for evaluating the quality, impact, and effectiveness of all activities will become a central element in Navigator Public Engagement initiatives. Formal and informal education programs will undergo annual assessment by the external and internal evaluators. Effectiveness of various initiatives will be determined based on assessing outcomes, continued feasibility, partnering effectiveness, and administrative ease. Assessments will involve surveys and interviews with customers, key stakeholders, and others, and will focus on both “process” and “outcomes.” A key quality assurance metric will be the ability to meet the changing needs in the education and public communities we serve.

1.0 FORMAL EDUCATION

“We’ve essentially seen the shadow of the planet,” Henry said.

Astronomer Greg Henry

Tennessee State University

– upon making the discovery of a
planet transiting a star

The CURE [Consortium for Undergraduate Research Experiences] program was instrumental in placing me back in the path of astronomy . . . My research experience, of which CURE was a large part, was a major contributing factor in obtaining my current position at the Keck Observatory.

Julie Rivera

Keck Observatory Assistant

1.0 FORMAL EDUCATION

The primary goal of Navigator Public Engagement's formal education initiatives is to support NASA's mission "to inspire the next generation of explorers as only NASA can." Navigator will focus on programs designed to nurture, support, and increase the pipeline of students who choose to pursue degrees in science, technology, engineering and math, and who choose to pursue careers within the greater NASA family of organizations and entities.

More than three million educators are responsible for over fifty million of our nation's school-age children. Beyond high school, 13 million students are enrolled in colleges and universities, where 43% are students enrolled in two-year (or community) colleges. The high percentage of students enrolled in community colleges choosing careers in teaching K-12 and education (pre-service teaching), makes this population a particularly important one for NASA and education overall.

Building measurable and sustainable programs with NASA-rich content and leveraged resources is critical to Navigator E/PO's work in formal education. While Navigator Public Engagement recognizes the importance of supporting education programs for students at all levels of the K-16 pipeline, it has chosen to focus the majority of its formal education resources on 1) community colleges, and 2) colleges and universities that serve minority and under-represented groups. An important link to the K-12 pipeline will relate to the pre-service segment of the community college audience. Navigator is also extremely committed to reaching younger students through its *informal education initiatives* detailed in the Section 2.0 of the plan.

In order to facilitate the organization of the content of the detailed program descriptions that follow in this section and in the next two chapters, each program is organized according to the following headings: 1) Description of Program, 2) Alignment to NASA Goals, and 3) Budget/Resources.

1.1 COMMUNITY COLLEGE INITIATIVE

Community colleges represent an important component in Navigator's formal education effort for several reasons, including the following:

- Community colleges represent a substantial segment of America's college-going population. In 2002, approximately 5.6 million students were enrolled in U.S. two-year colleges. In 2001, these same institutions awarded approximately 560,000 associate's degrees.
- Community colleges play a significant role in preparing future teachers (pre-service education). Reports indicate that between 25% - 50% of future teachers begin their education in community colleges before transferring to four-year credentialing institutions. Community colleges, therefore, present enormous opportunities for presenting Navigator's leading-edge science and technology, and inspirational activities to influence future K-12 instruction.
- Community colleges represent broad ethnic and cultural diversity. Eighty-five percent of underserved groups begin their education at a two-year college. Underserved populations receive a higher percentage of associates' degrees than bachelors' degrees. African-Americans, Latinos, and American Indians attain 20 percent of all associate's degrees, but only 15 percent of all bachelor's degrees.
- Community colleges represent a significant percentage of introductory astronomy instruction in the United States. More than 50% of all introductory astronomy instruction in the U.S. takes place at two-year colleges. Approximately 100,000 a year students receive instruction in astronomy in community colleges.

Community colleges are often overlooked in E/PO efforts due to the inherent challenges involved in reaching such a diverse and fragmented community. By investing in new programs, and working with a number of carefully chosen partners, Navigator E/PO believes that it is well-positioned to play an important role within this underserved segment of higher education. Navigator also considers its work with community colleges an evolving model, one with real challenges and opportunities, but also one which may provide a useful model and infrastructure for other NASA missions to take advantage of in the future.

Description of Program

Navigator's goal is to create a sustainable education program committed to increasing the quality of introductory astronomy teaching among community college faculty at a significant percentage of the 1200 two-year colleges in the United States. Navigator's three-year goal is to have an impact in over one-third of these institutions directly, and to create a framework for other NASA missions to participate in reaching this important community. By developing new "active learning" materials, investing in strong

partnerships, focusing on training and dissemination of these materials, and by directly linking to the education community through its Educator Advisory Board, Navigator is positioned to make an impact in astronomy instruction.

Navigator’s community college initiative has three components:

- 1.1.1 Linking to the education community
- 1.1.2 Partnerships for “active learning” materials , dissemination, and training
- 1.1.3 A dedicated website for astronomy faculty and students

1.1.1 Linking to the education community

Navigator has formed a group of advisory boards and partnerships made up of the following: 1) an Educator Advisory Board , 2) an Educator Working Group, and 3) the Two-Year Colleges for the 21st Century (TYC21) group.

Educator Advisory Board

This 23-member board is comprised of representatives from each of the other partnership groups, as well as individuals from the International Planetarium Society, the American Association of Physics Teachers (AAPT), NASA Space Grant–Two-year college group, and Tribal Two-Year Colleges.

The purpose of this board is two-fold: 1) to act as all overall review body that represents diverse viewpoints from around the country, and 2) to provide a platform for early adoption and dissemination of materials and training (including hosting regional workshops for training, and nominating faculty peers for workshop stipends–see below). The board will formally convene at least once a year in-person, and also communicate through teleconferences and email. Table 1 below lists the members of this board

Table 1. – Educator Advisory Board

NAME	TITLE	COLLEGE	S
Cliff W. Fenton*	Instructor of Astronomy	Nicholls State University	LA
Dave Owen	Assoc. Prof. of Astronomy	Bristol Community College	MA
Jack Owens*	Professor of Physics	Community College of RI	RI
Dan Durben	Associate Professor	Black Hills State University	SD
David Falk*	Planetarium Director	Los Angeles Valley College	CA
Bart J. Lipofsky	Professor of Astronomy	Brevard Community College	FL
Terrence	Professor of Physics	College of St.	MN

Flower		Catherine	
Tim Olsen*	Professor, Science Department	Salish Kootenai College	MT
Dan Loran	Professor of Physics & Astronomy	Truckee Meadows Community College	NV
Darren Williams	Asst. Prof. Physics & Astronomy	Penn State, Erie	PA
Nora Andreasian-Thomas*	Associate Professor	University of Virgin Islands	VI
Peg Stanley*	Deputy, Public Outreach	STScI	MD
Judit Ries	Research Scientist	University of Texas	TX
John Sepikas	Asst Prof Math	Pasadena City College	CA
Bob Madsen	Instructor in Science	Chief Dull Knife College	MT
Grady Price Blount	Chair, Dept. of Physics & Life Sciences	Texas A&M - Corpus Christi	TX
David Pierce	Prof. Astronomy & Physics	El Camino Community College	CA
Mary Beth Monroe*	Department of Physics	Southwest Texas Community College	TX
Marie Plumb	Professor of Physics	Jamestown Community College	NY
Marni Berendsen*	ASP Education & Outreach	Astronomical Society of the Pacific	CA
Timothy Dave	Department of Physics	San Jose City College	CA
Carolyn Mallory	Professor of Astronomy	Pierce College	CA
David Drew	Consultant/Dean of Students	Claremont College	CA
Beth Hufnagel*	Assistant Professor	Anne Arundel Community College	MD

Educator Working Group *

Nine members of the advisory board have agreed to serve as an Educator Working Group. This group will act as a steering committee and will provide direct input and evaluation for the design of materials, programs, and training. The working group will convene four times a year (at national or regional conferences, and through teleconferences). The members of the Educator Working Group are asterisked in Table 1 above.

Two-Year Colleges for the 21st Century (TYC21)

The American Association of Physics Teachers (AAPT) and the Two-Year Colleges for the 21st Century (TYC21) group within AAPT represents a network that reaches an introductory astronomy community of over 100,000 students annually. TYC21 has agreed to provide support and input in the following ways: 1) to provide input to the development of materials, 2) to share a national database of community college science instruction, and 3) to support regional workshops (see below) with local community college instructors from the AAPT/TYC21 network as co-presenters.

1.1.2 Partnerships for active learning materials , dissemination, and training

Navigator Public Engagement is working with experienced partners to develop and disseminate materials, and train faculty. The core set of initiatives has two components: 1) regional teaching excellence workshops and 2) national symposia for two-year colleges focused on improving Astronomy 101 survey courses.

“Teaching Excellence” Workshops

The Conceptual Astronomy and Physics Education Research (CAPER) Team at the University of Arizona is helping Navigator develop a series of lecture-tutorials for community colleges that utilize active-learning materials. While a large number of students take introductory astronomy courses each year, research suggests that students do not understand or retain fundamental concepts beyond those beliefs they had entering the course. Also, because many students in introductory astronomy courses are future teachers (pre-service teachers), the modeling of quality instruction for teaching becomes critical.

Dr. Tim Slater and Dr. Ed Prather, astronomers at the University of Arizona specializing in the scholarship of teaching and learning, are leading the effort to develop these new active learning materials. Both professors have extensive experience in conducting workshops and frequently are invited presenters at the American Astronomical Society, American Association of Physics Teachers, Society of College Science Teachers, and American Geophysical Union national meetings.

With input from Navigator and the Educator Working Group, CAPER is creating and field-testing lecture-tutorials for collegiate non-science-major classrooms. While the initial focus is on concepts related to Navigator science education threads, all courses aim to reinforce fundamental concepts in astronomy. The first series of three lecture-tutorials will include the following topics: (i) techniques in astronomy; (ii) tools and telescopes; and (iii) the nature of light. The tutorials will be supplemented by newly developed animations and videos.

In order to disseminate the new materials and teaching techniques, Navigator—in partnership with CAPER—is implementing an on-going series of three-day teaching-excellence workshops to be held around the country for community college instructors (including adjunct instructors). Ten of these all-day workshops will be convened every year with an average of 25 faculty participating in each workshop. The annual impact of these workshops will be to reach and train 250 faculty. Working with the advisory board,

Navigator will seek to achieve the broadest participation possible. Particular attention will be paid to involving faculty representing diverse communities.

National Symposia for Improving Astronomy Instruction

Working the Astronomical Society of the Pacific and the CAPER team, Navigator will expand its reach even further with the creation of a series of national hands-on symposia dedicated to improving the teaching of the Astronomy 101 survey course. The conferences will host 100 to 200 faculty and adjunct faculty and will focus on teaching astronomy and space science at community and other non-research-oriented colleges. The first symposium will be held in the summer of 2004 at Tufts University in Boston. Partners for the first conference include:

- The Astronomical Society of the Pacific
- The American Astronomical Society
- New England Space Science Initiative in Education
- Tufts University Department of Physics & Astronomy
- New England Space Grant Consortium
- Museum of Science, Boston

1.1.3 A dedicated website for astronomy faculty and students

A dedicated website for community college astronomy faculty and students is currently under development. This site will provide a central location for a number of useful resources, including: 1) educator resources for teaching astronomy, 2) information about relevant news and events, 3) a calendar of workshops and professional development opportunities, and 4) a list of educational activities and opportunities around the country, populated in part by member input, and 4) a compilation of best practices and lessons learned. A faculty newsletter is also being considered as a future communications vehicle.

Metrics, Impact, and Evaluation

The potential impact of these programs will be significant. Navigator is compiling a database of community college astronomy instruction in the United States. There are approximately 1200 community colleges in the US. TYC21 uses a designation of 15 geographical regional chapters for its member institutions. Navigator has a three-year goal of reaching a third of these institutions directly, with participation from institutions in 80% percent of the regions within a three-year period. The ten teaching-excellence workshops will reach 250 faculty each year with another 100-200 faculty reached through the national symposia. If each faculty member in turn impacts 100 students, the annual impact could reach 35,000 to 45,000 students each year.



The effectiveness of Navigator's community college initiative will be evaluated in two ways:

- 1) **Individual Component Effectiveness:** CAPER and ASP are each responsible for designing evaluation criteria related to program effectiveness and impact of the regional workshops and national conferences. They will submit evaluation reports based upon participant assessments of program effectiveness, perceived improvements in specific teaching skills, and overall professional development. Follow-up assessments will also be made to gauge the use of these tools and techniques in the classroom through telephone interviews and email correspondence. An assessment of the overall number of students reached through the enhanced teaching methods will also be undertaken, with a special assessment of the impact on pre-service students.
- 2) **Overall Program Effectiveness and Impact:** An annual evaluation of the overall effectiveness will be undertaken by the Educator Working Group with additional input from Navigator's outside evaluation expert (Dr. David Drew) who is a member of the Educator Advisory Board. This evaluation will involve a review of the component evaluation reports and follow-up assessments with key stakeholders and customers.

Alignment to NASA Goals

Navigator's community college initiative aligns with the following NASA strategic goals and objectives:

	Goal	Objective				Goal	Objective	
	6	6.1	6.2	6.3	6.4	7	7.1	7.2
Meets	✓	✓	✓	✓	✓			

Strategic objective 6.4 (improve higher education capacity to provide for NASA's and the Nation's future science and technology workforce requirements) is met directly with this initiative. The use of Navigator-specific science threads and inquiry-based active learning modules aligns with objective 6.3 (unique teaching tools and experiences that only NASA can provide) and objective 6.1 (Improve student proficiency . . . by creating a culture of achievement). Objective 6.2, to "motivate K-16+ students from diverse communities to pursue science and math courses and, ultimately degrees in science, technology, engineering, and mathematics" is addressed through harnessing the energy of the substantial pre-service community. Also, the core value of reaching students from diverse communities is tested in this effort in the inherent diversity of the community college population.

Budget/Resources

Several Navigator staff are involved in the direct support of the Community College Initiative, as well as a dedicated education specialist in the area of community college education from JPL's Office of Education. Also, the partnerships with CAPERS, TYC21, and the ASP bring additional resources to bear in the form of dedicated PIs and science mentors, database capabilities, and a network of advisors. From 2003 to 2005,

approximately \$600,000 is budgeted for staff, partnerships, materials development and distribution.

1.2 NAVIGATOR RESEARCH EXPERIENCES FOR MINORITIES

Description of Program

Over the next 10 years, the United States will need to train and educate an additional 1.9 million workers in the sciences in order to meet projected workforce needs. Recent enrollment trends indicate that increased involvement of underrepresented groups is essential in meeting this demand. Racial minorities make up 24 percent of the population, but only 7 percent of the science and engineering workforce.

The target audience for the Navigator minority research experiences are faculty and students at minority-serving institutions, which include historically black colleges and universities (HBCUs), Hispanic serving institutions (HSIs), and tribal colleges. Navigator is currently working with two different institutions, Tennessee State University, an HBCU, and California State University Los Angeles, an HSI.

An advisory board has been formed to assist Navigator Public Engagement with its investments in this area. Advisory board members include representatives from several minority-serving institutions, as well as JPL representatives:

Name	Title	Affiliation
Dr. Willard Smith	Professor, Center of Excellence in Information Systems	Tennessee State University
Dr. Donald Walter	Associate Professor of Physics	South Carolina State University
Dr. Geoffrey Burks	Research Specialist, Astronomer	Tennessee State University
Dr. Stephen Gilliam	Director, Consortium for Undergraduate Research Experience	Jet Propulsion Lab
Dr. Susan Tereby	Research Specialist, Faculty	California State University, Los Angeles
James Harrington	Manager	Minority University Space Interdisciplinary Network Goddard Space Flight Center
Eva Graham	Manager	JPL Minority Education Initiatives Manager
Linda Rodgers	Manager	JPL Student Programs

The role of this advisory board is to act as a steering committee to provide input and guidance to the program's overall direction, and to help evaluate the effectiveness of the program. The board will convene twice a year, either in person, or via telecon.

Navigator Public Engagement will leverage its experience with the Michelson Fellowship Program and summer school, and its relationship with program scientists and engineers to expand existing research mentoring programs and to pilot a new summer research

program. The metrics for these investments are necessarily small, as only a limited number of students can be given the kind of in-depth attention required from the programs. However, these programs have the potential for high and sustainable impact, particularly related to career choices and employment options. Over time, Navigator will expand the the pilot program to include participation of students and faculty from other minority-serving institutions.

The Navigator Research Experiences for Minorities has two components:

- 1.2.1 Support and expansion of existing research experiences with the Consortium for Undergraduate Research Experiences (CURE)
- 1.2.2 A three-year pilot program for undergraduate summer research

1.2.1 Support and expansion of existing research experiences with CURE

Navigator Public Engagement is partnering with the Consortium for Undergraduate Research Experience (CURE) to provide authentic science and research opportunities to a diverse group of community college students in the southern California region.

CURE is funded as one of the NSF Research Experiences for Undergraduates sites for astronomy. Forty-two undergraduates enrolled in CURE between 1999 and 2002. Sixty-three percent (27) of them were from underrepresented minorities, 35.7% (15) were women, and 80% of these transferred to or intend to transfer to a four-year college. The program works to encourage minority students and women to select science, engineering, or technology as a career. CURE has a cadre of committed research mentors at JPL who have collaborated with the students on fourteen different research projects, including photometry and astrometry. CURE students were co-authors or shared observational credit in forty-six reports and presentations.

Ten to twelve students a year receive cutting-edge research experiences with CURE mentors. In 2003, Navigator supported a National Science Foundation proposal submitted by CURE; the proposal was awarded a grant of \$500,000. This funding will allow CURE and Navigator to provide year-round mentoring and research experiences to approximately 65 students from 2004 to 2008. Navigator will steadily increase the number of mentors and students in this program through direct financial assistance, as well as through the recruitment of more mentors from the Navigator workforce ranks. The longer-term goal is to expand this support to include other regional REU (Research Experiences for Undergraduates) programs around the country, with an emphasis on regions co-located with Navigator science teams.

1.2.2 A Three-Year Pilot Program for Minority Undergraduate Summer Research

Navigator is piloting a summer research program beginning in 2003. The partner for the eight-week 2003 summer program was Tennessee State University. Tennessee State is designated as a Historically Black College or University (HBCU) and maintains a vibrant

astronomy and astrophysics program (Professor Greg Henry was a member of the science team responsible for discovering the first extrasolar planet using direct transit detection).

The Navigator-sponsored summer program included a seven-week research program based on an expanded version of one of the projects from the Navigator Program's Michelson Summer School. Students began with a three-week review of optics, telescopes and CCD-cameras. Students participated in several hands-on experiences including an observing run: first, the process of creating an observing program was explored, from target selection and vetting of suitable calibration objects to performing the actual observations. Students spent the eighth week at JPL, where they presented their study projects to JPL scientists and also became familiar with the Lab's operations and employment opportunities (JPL employs over 500 students every summer in various capacities around the Laboratory working with technologists and scientists). Future summer programs will explore opportunities for participants in the JPL summer program.

Beginning in 2004, the summer research program will involve students from South Carolina State and will expand to include other HBCUs, HSIs, and tribal colleges in the future. The program will also be supplemented with travel grants for researchers at minority institutions to attend professional meetings and conferences.

Navigator will also coordinate its undergraduate initiatives with the newly established MSC science communication outreach group, which will begin funding a set of undergraduate Michelson Educational Awards in 2004. These awards are aimed at supporting educators and institutions in the preparation and presentation of educational material relevant to Navigator Program science (e.g., extrasolarplanet research) and/or technology. Awards are anticipated to be in the range of \$35,000 to \$75,000. Navigator management has agreed to serve on the advisory board of the awards committee and will encourage students and faculty participating in its research programs to apply for these awards once the program is fully established.

Navigator's goal during the three-year pilot phase of this initiative is to involve students from at least five different minority-serving institutions in the country. After year three, Navigator will assess and evaluate the program's impact and success and determine the most appropriate path for continued support and expansion. This evaluation will be carried out with input from the advisory board, as well as an outside evaluator. It will involve both process and outcome assessments based on interviews and surveys with students, faculty, mentors, administrators and other stakeholders.

Alignment to NASA Goals

Navigator's research experiences initiatives aligns with the following NASA strategic goals and objectives:

	Goal	Objective				Goal	Objective	
	6	6.1	6.2	6.3	6.4	7	7.1	7.2
Meets	✓	✓	✓	✓	✓			

Objective 6.4 (Improve higher education capacity to provide for NASA's and the Nation's future science and technology workforce requirements) is met directly with this initiative. The use of Navigator-specific research projects as well as direct involvement of Navigator scientists and engineers furthers objective 6.5 (unique teaching tools and experiences that only NASA can provide) and 6.1 (creating a culture of achievement, using educational programs, products, and services based on NASA's unique missions).

Budget/Resources

Dedicated Navigator E/PO staff, Navigator scientists, and minority university faculty are the key workforce resources allocated to this initiative. Navigator's effort in this area will increase over time. The 2003 investment in the summer program for Tennessee State University is \$40,000. Navigator Public Engagement has allocated approximately \$400k to the development and support of these programs through FY05. In addition to workforce, this budget will allow the development of infrastructure for summer programs, workshops, travel stipends, and institutional contracts.

Sidebar: Julie Rivera – Biomed to Keck 10-Meter Observatory

* * * * *

The Consortium for Undergraduate Research Experience mission is to recruit, train, and retain underrepresented minorities in science and engineering.

I was born July 4, 1979 the youngest of seven in Alhambra, CA. At Alhambra High School I enrolled in the Biomed program. I worked in a laboratory and presented my research at annual science fairs.

I started taking classes at Cal. State Los Angeles with the ACE/PACE program while still in 10th Grade. There I met Dr. Milan Mijic (a Physics professor and director of CURE until 2002) and started working in astronomy.

I worked on comet light-curves from data obtained at the NASA/JPL Table Mountain Observatory. This was partly funded by a grant from the California Museum of Science and Industry (CMSI). I was one of the first CURE students in 1998. I obtained a B.A. degree in Astronomy and Computer Science from Pomona College, CA. I chose this school partly because they owned a telescope at the NASA/JPL Table Mountain Observatory. After graduation, I worked as a substitute teacher and web designer until obtaining the job at Keck. I am now living on the Big Island of Hawaii and working as an observatory assistant; operating one of the twin 10-meter Keck telescopes and aiding researchers. Dr. Bonnie Buratti (a JPL Principal Investigator and CURE mentor) was my college thesis advisor. She was a visiting professor teaching Planetary Astronomy.

The CURE program was instrumental in placing me back in the path of astronomy and helped me hone my research techniques. The projects I participated in while a CURE student took me to the Atlanta, Georgia AAS annual meeting of 2000. There I met many wonderful colleagues and absorbed information on the current and future directions in astronomy. My research experience, of which CURE was a large part, was a major contributing factor in obtaining my current position at the Keck.

2.0 INFORMAL EDUCATION

It may seem silly, but when I think back on visits to Hayden as a child, what I remember most are a set of now-antiquated mechanical scales which gave you your weight on various objects within the Solar System. For me, "immersion" was everything -- being able to draw a picture in my mind of what it would be like to visit different worlds.

*Grace Wolf-Chase
Adler Planetarium*

For amateurs engaged in the search, the quest can be a life-altering experience . . . "What drives me is the childlike wonder – the awe I have doing this in the shadow of some very smart, very good people."

October 24, 2002
The Christian Science Monitor
on one amateur planet hunter's passion
to search for extrasolar planets

2.0 INFORMAL EDUCATION

Navigator Public Engagement views informal education as the creation of “opportunities for life-long learning,” many of which intersect and enhance formal education programs. This may include the engaging experiences available in museums, science centers, planetaria, libraries, youth groups, and community organizations. Informal education venues allow for the building of additional bridges to the same critical audiences NASA needs to reach as a part of its mission to educate and inspire the next generation of explorers, including those disenfranchised in science, math, and technology.

Informal education provides inquiry-based learning and opportunities for discovery, where participants may engage in fun and creative activities while gaining science literacy. These venues and organizations can have the power to create lasting impressions, to excite and inspire audiences in ways that are real and immediate, and engage participants to consider larger scientific and philosophical questions. Whether it’s a child playing a new planet-finding game in the PlanetQuest section of the Origins exhibit, or a Girl Scout looking through a telescope at a star party, trying to home in on the star around which the latest planet was discovered, these are exciting opportunities for engagement and enrichment that are often more of a challenge to achieve in formal settings. Navigator Public Engagement will incorporate the two science threads of “the diversity of worlds,” and “what light can tell us” into its informal education activities.

Navigator E/PO’s work in informal education will consider the following:

- Understanding audience needs. Working with our partners, educators, evaluators, and NASA scientists, Navigator E/PO will work to put audience needs first. This includes exploring ways in which larger messages and themes can be addressed through thoughtful development of activities and materials that can be adapted by various NASA missions and themes.
- Leveraging existing programs/venues to the extent possible. Navigator E/PO will take advantage of natural synergies with the formal education and public outreach components of this plan, developing content that can be repurposed for various settings, and working with partners who can extend the reach and assets of each initiative.
- Allowing for appropriate planning horizons. Planning horizons for some initiatives, such as museum exhibits, may stretch over several years. Planning must include an understanding of this framework, and provide a framework for building relationships, seeking out additional opportunities, and understanding the investment/payback time horizon.

Sidebar: Getting "turned on" to astronomy – One scientist's story

* * * * *

Advisory board member Grace Wolf-Chase of the Adler Planetarium in Chicago shared the following personal story of how informal education influenced her when she was a young girl growing up in the lower-middle class suburbs of New York City.

Unlike many in the academic community, I do not come from an academic background. My maternal grandmother came from a very poor family in Germany (Saxony), where she was sent to work on a farm for "rich people" at the age of 13. Her schooling amounted to completing the eighth grade. She immigrated to the U.S. with her husband and son in the late 1920s. My mother was born in the U.S. After a very brief and unhappy marriage, my mother raised me as a single parent (with help from my grandmother), while working seven days per week as a private-duty nurse at Columbia Presbyterian Medical Center in New York City. Her salary put us in the "lower middle class" category.

Three things stand out in my mind as major sources of inspiration in my early childhood:

- (1) Star Trek (yes, I know this will elicit groans from some ...)
- (2) The televised Apollo space program (in spite of its all-male attribute)
- (3) Visits to the Hayden Planetarium/ American Museum of Natural History

You will notice that all of these sources belong to informal, not formal, education. It may seem silly, but when I think back on visits to Hayden as a child, what I remember most are a set of now-antiquated mechanical scales which gave you your weight on various objects within the Solar System. For me, "immersion" was everything -- being able to draw a picture in my mind of what it would be like to visit different worlds. The great allure of Star Trek is no mystery -- it portrayed science as the driving force, the spirit, of exploration, which is too often missing in the way science is presented in schools. It also painted the picture of a diverse community that got along and overcame trivial differences by reaching for common, and noble, goals.

It made strong points about the follies of humanity -- anyone remember the show about the two races that were half-black and half-white on different sides? It also made some strikingly accurate predictions of future technology -- probably because some imaginative writers came up with such clever ideas, they were "jumped on" by the techies who said "Let's make this happen!"

In my mind, these successes far outweigh the relatively minor misconceptions that were imparted, primarily due to TV constraints, and the silly "technobabble" that is often employed to make a description sound impressive to the non-science public.

At a time when there were very few female role models in the space sciences (if any), Star Trek taught me that with enough interest and perseverance, and yes, idealism, too, I could become whatever I wanted to be. I won't say it's been an easy road, but it has been worth the effort.

2.1 THE NIGHT SKY NETWORK INITIATIVE (ENGAGING AMATEUR ASTRONOMY CLUBS)

Description of Program

Navigator Public Engagement believes that harnessing the energy and enthusiasm of the members of amateur astronomy clubs will play a central role in Navigator's ability to create a meaningful public engagement and education program designed to leverage and expand the reach of Navigator missions and focus on helping to inspire NASA's next generation of explorers.

Working with the Astronomical Society of the Pacific, the Astronomical League, and Transitsearch.org, Navigator will develop a community of amateur astronomy clubs and professional astronomers linked to formal education venues, such as high schools and community colleges, and to informal education venues such as libraries and science museums to bring the extraordinary technology and science of the Navigator missions to students, teachers, and others across the country.

Before discussing Navigator's Amateur Astronomer Program, a brief review of why amateur astronomy clubs are an important audience for NASA and for Navigator Public Engagement includes the following elements:

- Amateur astronomers and the astronomy clubs many belong to represent a large and identifiable community of enthusiasts. While as many as 300,000 individuals engage in some sort of amateur astronomy, recent estimates suggest that there are on the order of 50,000 active amateur astronomers affiliated with clubs in the United States and more than 675 astronomy clubs.
- Amateurs exhibit a high level of interest in extrasolar planets. When questioned about their interest in the search for extra-solar planets, planetary astronomy, and astrobiology in a recent survey, 82% of respondents claimed to be highly interested, or somewhat interested.
- Astronomy clubs currently engage in public outreach on a regular basis. According to the same survey, 63% of the amateur astronomers surveyed are currently engaged in some form of educational outreach. Of those that do outreach, 34% hold at least one event per month. Almost all clubs invite the public to astronomy nights (star parties) where members share views of the sky through their telescopes. Clubs conduct these events at no charge to the participants, providing access to all segments of the community. Astronomy clubs offer their communities the opportunity to call upon their members to conduct events for such groups as Girl Scouts, senior centers, K-12 classrooms, and service organizations, to name a few.

- Astronomy Clubs provide a vital link to community colleges and other formal education initiatives. K-12 school groups comprise 70% of the audience for amateur astronomers, according to the ASP survey. Many community colleges have a planetarium and sponsor an astronomy club.
- Amateurs are increasingly interested in opportunities to contribute to *real science research* and meaningful explorations of the cosmos. Increasing numbers of amateurs are owning and using sophisticated instruments and accessories to do their observing: spectrometers, CCD and video cameras, computer-controlled programmable telescope drives. A look through an amateur astronomy magazine will reveal the breadth of instruments and accessories available to the amateur. Amateurs are interested in opportunities to use their extensive (and expensive!) equipment to be involved in research.
- That Navigator missions all use telescopes for *seeing into the universe* provides context. Public astronomy nights (star parties) hosted by amateur clubs are often the first and only opportunity for children and many adults to look at a variety of objects in the sky through telescopes. This simple act generates a curiosity and excitement that, in many cases, lasts a lifetime and certainly changes their understanding of the heavens. Connecting what is seen through the telescope to NASA research and missions will be a tremendously powerful message.

Navigator Public Engagement's Night Sky Network has the following three components:

- Astronomy Clubs and Presentation Resource Kits
- Community Building, Professional Development, and Training
- Authentic Science Opportunities: Looking for Planets

2.1.1 Astronomy Clubs and Presentation Resource Kits

The Astronomical Society of the Pacific conducted a recent survey of more than 1100 amateur astronomers, which found that amateur astronomers are already actively involved in outreach and education. More than 60% of the amateurs surveyed participate in some educational outreach, with 71% of those participating between 8 and 52 times a year.

Two-thirds of the ASP survey respondents cited the need for "effective materials" as the category that would most facilitate and improve educational outreach. When asked about the type of material they would be likely to use, 68% chose ready-made, targeted, hands-on activities for teaching, while posters, software, slides, and curricular material were also selected as important by a smaller percentage.

Working with the ASP and the Astronomical League, Navigator Public Engagement will plan, develop, manufacture, and disseminate a Presentation Resource Kit (PRK) designed to assist amateur astronomy clubs in conducting outreach and education events related to Navigator missions, the night sky and extrasolar planets, and telescopes.

The PRKs will be developed with an advisory board of amateur astronomers, with involvement from Keck, SIM, TPF, and LBTI scientists and engineers, and the ASP and Astronomical League. The development phase of the initiative will define the precise nature of the kits, but some example of what they might contain include:

- Sky maps indicating the location of extrasolar planets in the night sky
- Tours of the sky through the telescope to tell the story of star and planet formation
- Video clips and/or animations
- Still images (digital images from which photographs, slides, and transparencies can be produced)
- Hands-on activity guides
- Presentation scripts
- Written content tutorial materials and/or web-based tutorials
- Guides to web-based resources for additional content knowledge, mission updates
- Small demonstration devices allowing participants to discover such ideas as:
 - The diversity of planetary systems
 - Methods to discover extrasolar planets
 - What can be learned from the light of stars and the spectra of planetary atmospheres
 - The benefits of using telescopes and putting them in space

These kits will be designed to be used in a variety of settings, including the classroom, youth group meetings, and community college events, as well as outside under the stars. Kit activities and materials focus on an informal, inquiry-based approach to learning, centered around the two Navigator education science threads of the “diversity of worlds” and “what light can tell us.”

Linking the PlanetQuest Story to the Night Sky

Ninety-one percent of the amateur astronomers surveyed say they are very interested in observable objects. One of the challenges involving extrasolar planets is that these planets are not directly observable. However, many of the parent stars of the 100 planet discoveries are observable. Navigator will work to convert the high *general interest* in extrasolar planets into a high *specific observing interest* by developing, creating, and disseminating constellation maps of stars with extrasolar planets. These maps will be archived, updated, and readily available on the PlanetQuest website, and it will be linked to the current database of extrasolar planets.

Amateur astronomy clubs will use these maps during public events to assist participants in finding the stars with planets and finding other objects that scientists study to contribute to the knowledge of how stars and their planets form.

2.1.2 Community Building, Professional Development, and Training

Building a national community of amateur astronomy clubs whose members are knowledgeable, enthusiastic, and equipped to conduct effective outreach and education events, and who can share stories of science and observing as it relates to extrasolar planets is key to Navigator Public Engagements efforts in this area. NASA/JPL's Solar System Ambassador program is an example of one extremely effective model of a national community.

Many amateur astronomers consider themselves to be a part of their local communities through their astronomy clubs, museums, and regional events. But the following comments—taken from the ASP survey—provide additional insight into on-going needs that fall into the category of the desire for an expanded community. Amateurs expressed interest in more opportunities for:

- Networking/access to experts/exchange of ideas
- Interaction with other like-minded people
- Interchange with other contributors
- Access to an expert
- Exchanging ideas, seeing what others do, seeing what the pros do
- Sharing ideas with others, sharing experiences
- Learning about other successful programs already in place
- Getting tried and tested ideas from others

Building a national community will require developing and supporting the sense of a community across much greater distances than current city, state, and regional boundaries. The concept of a community may involve several components, including shared interests and goals, frequent interaction, a meeting place, and the ability to swap/exchange stories, experience, and information. Additional aspects of building a vibrant community for this initiative include:

- **Connecting to Scientists and Engineers.** Navigator E/PO believes in the importance of bringing amateurs and professionals together. Navigator will involve scientists from all of its missions, including SIM, Keck, TPF, LBTI, and MSC as resources, NASA story-tellers, and mission experts, to help bring real planet-finding missions to life. Navigator will also involve Michelson Fellows as advocates in this program. Navigator scientists and engineers have the very real power to inspire and excite this group of amateur enthusiasts and to help further NASA's goal of *engaging the public in shaping and sharing the experience of exploration and discovery*.
- **The Night Sky Network Internet Hub** The Internet will be used to provide an electronic hub for the Night Sky Network, enabling members around the country to communicate with each other, with mission scientists, and with the Navigator Public Engagement Team. It will also allow them to send and receive information

about news and events. The website will exist within the PlanetQuest domain and serve as a vital resource for amateur astronomers and others who wish to participate in a growing body of initiatives. A monthly bulletin of news and events will be e-mailed to all members and posted on the site; the site will also include an Event Calendar, continuously updated with activities around the country, populated in part by member input.

- **Recruiting a More Diverse Population of Amateurs** Surveys reveal that while the ranks of amateur astronomers is not particularly diverse, an opportunity exists to inspire and recruit members from more diverse backgrounds, including more women and girls, more ethnic minorities, and more younger men and women. Navigator Public Engagement will seek out minority and women amateurs as role models, and work to connect them to individuals in underserved communities. Inviting them for lectures, public events, training, or creating web spotlights are a few of the ways to build bridges to a more diverse community.

Training amateur astronomers to effectively use new education and outreach materials is also essential to the ultimate success of the Night Sky Network program. The following are seen as key categories by survey respondents, with content and communication skills topping the list.

What kind of training would you seek in a workshop?

<i>Training</i>	<i>Percentage</i>	<i>Count</i>
Content	73%	426
Communication skills/teaching	56%	327
Technical skills	47%	275
Marketing, PR	30%	175
Total other	10%	56
Totals	n/a	583

Navigator Public Engagement, working with the ASP, will design and implement an appropriate training program that will include web-based training and face-to-face workshops. Web-based training will include live interactive webcasts that will be open to all club members. These webcasts will provide direct links to materials and also provide a forum for club members to have immediate access to scientists. In-person workshops will involve Navigator E/PO staff and, where feasible, Navigator scientists. Navigator E/PO will seek the most effective and accessible venues in which to conduct workshops, including regional amateur conferences and science centers. Training in the use of kit materials will model and encourage an inquiry-based approach to presenting activities.

2.1.3 Working with Amateurs Looking For Planets

The third component of the program involves a partnership with an Ames-based group called Transitsearch. Transitsearch is beginning to work with amateurs to explore the possibilities of directly detecting planets with new “home-grown” equipment. Navigator Public Engagement will capture the excitement of exploring new worlds with amateur astronomers by connecting a select group of advanced amateurs to outreach and science opportunities.

Armed with a tele-lens, a CCD detector and a personal computer, some scientists believe amateurs may be able to contribute to authentic science in the search for extrasolar planets, to confirm the existence of extrasolar planets using transit detection, or—sometime in the future—actually discover new extrasolar planets (gas giants). The current efforts of amateurs in this arena are an exciting development on the astronomy horizon, and provide a potential platform for more engaging public outreach and education. This collaboration offers the potential to make the story of “the search for another Earth” even more real and meaningful to students, teachers, and the general public by showing how space exploration is not only within the reach of professionals.

The effort will include the recruitment of more advanced amateurs to participate in the effort to confirm known planets for the first time through direct detection. Navigator Public Engagement will seek out ways to bring amateurs and professionals together to *show how technology makes discovery possible*, and also to share ideas for ways to involve more students and teachers in this new frontier.

Sidebar: Amateurs And Planetfinding

* * * * *

October 24, 2002 edition

EYE ON THE SKY: Software executive Ron Bissinger is part of an emerging cadre of amateurs helping professional astronomers in extrasolar planet exploration.

TONY AVELAR/SPECIAL TO THE CHRISTIAN SCIENCE MONITOR

Planet hunters

By day, they work in many fields. By night, they help professional astronomers search for faraway worlds.

By Peter N. Spotts | Staff writer of The Christian Science Monitor

A suburban backyard nearly an hour's drive north of San Jose, Calif., might seem to be an unlikely spot for taking part in one of modern astronomy's grandest adventures.

Yet when the last faint glow of dusk vanishes from cloudless skies, Ron Bissinger is likely to head to his modest garden-shed observatory to begin his search for worlds beyond our solar system. A software-company vice president by day, Mr. Bissinger is one of a handful of amateurs helping to create a potentially worldwide collaboration between amateur and professional astronomers.

Their common cause is the search for planets that eclipse their parent stars. Such backlit planets can reveal characteristics that could lead to the discovery of a world beyond our sun's reach that displays evidence of organic life.

Five years ago, the notion of enlisting amateur astronomers in extrasolar planet exploration probably would have drawn snickers at an astronomy conference. The task would have been deemed too difficult for equipment available to the backyard enthusiast.

But two years ago, a team of amateurs in Finland observed the transit of a planet orbiting a star 150 light-years away in the constellation Pegasus.

. . .

the prospect of participating with the pros in one of astronomy's cutting-edge fields is too alluring to pass up, he adds. "What drives me is the childlike wonder – the awe I have doing this in the shadow of some very smart, very good people."

Metrics and Evaluation

Short Term Goal: 500 Public and Educational Events Within One Year of Operation

Navigator E/PO expects to be able to document at least 500 events in which the PRKs were used within one year of implementation. Over the next two years, Navigator Public Engagement and ASP will develop, beta test, and distribute between 150 and 200 PRKs to a minimum of 100 astronomy clubs around the country. Each of the 100 astronomy clubs receiving a free Presentation Resource Kit will agree to a minimum of five events per year. A designated outreach coordinator in each club will be responsible for tracking and submitting evaluation reports, as well as encouraging, supporting, and tracking the use of these materials in a variety of public outreach events and programs.

Linking to Launches and Astronomical Events: While the launch of the Kepler mission in 2007 and the SIM mission in 2009 will provide multiple opportunities for education and outreach events related to planet-finding, shorter-term astronomical events, such as the rare June 8, 2004 transit of Venus across the Sun, provide a unique opportunity to highlight, discuss, and educate the public and students about one of the key methods used by NASA missions (and possibly amateurs) to detect extrasolar planets. Navigator Public Engagement will explore ways to capture the public's imagination with this rare event by partnering with the Sun-Earth Connection Forum and Kepler outreach, astronomy clubs around the country, poised to engage in a network-wide dialogue.

Evaluation: Ten percent of the budget for this initiative is earmarked for evaluation. The Institute for Learning Innovation (ILI) based in Annapolis MD has been engaged to evaluate and test the effectiveness and impact of this program, including:

1. the creation of measurable objectives
2. design of alpha and beta testing processes
3. on-going formative evaluation
4. summative evaluation after the initial distribution of kits

What are the learning goals for amateurs astronomers and their audiences? How are the kits actually used? How can an effective community of education and outreach enthusiasts be supported and expanded? These questions and others will be addressed through the formal evaluation process.

Alignment to NASA Goals

Navigator's Night Sky Network initiative aligns with the following NASA strategic goals and objectives:

	Goal	Objective				Goal	Objective	
	6	6.1	6.2	6.3	6.4	7	7.1	7.2
Meets	✓	✓	✓			✓	✓	✓

Working with amateur astronomers to create a national network of enthusiasts laboring on behalf of NASA to inform and educate students, teachers, and the general public aligns well with NASA's strategic goal 7, "Engage the public in shaping and sharing the experience of exploration and discovery." This program will allow amateur clubs to "translate and deliver engaging NASA content" (objective 7.1) and to "improve science literacy by engaging the public in NASA missions and discoveries" (objective 7.2). By focusing on activities that follow naturally from looking at the sky, the public and students become informed and curious about the story of star and planet formation and the methods to search for extrasolar planets. The search for extrasolar planets becomes real by gazing through the telescope at the night sky. NASA's goal 6 is also addressed through the involvement of amateurs with schools and afterschool programs, and by interacting with students in public forums.

Budget/Resources

Navigator E/PO will commit significant resources to developing the Night Sky Network program, including the full-time involvement of an amateur astronomer and outreach specialist, the creation of targeted resources related to Internet development and support, and support from community college, minority university and informal education staff coordinators. Navigator will also leverage the use of partnerships bringing unique capabilities and connections to this world, including the ASP, the Astronomical League, Sky & Telescope Magazine, and others. Approximately \$475,000 will be committed to this initiative through FY 2005 to cover labor, materials development and distribution, and training.

2.2 GIRLS IN SCIENCE – GIRL SCOUTS INITIATIVE

Description of Program

Women represent only 22 percent of the science and engineering labor force today (NSF, Science and Engineering Indicators, 2000). Research shows that girls and boys do equally well in tests and grades in science, mathematics, and technology during the elementary years, yet girls tend to drop out of science, math and technology earlier than boys. Navigator Public Engagement is working with the Solar System Exploration Forum (SSE) to provide training and mentoring opportunities for girls through a NASA partnership with the Girls Scouts of the USA (GSUSA). The SSE Forum is taking the lead in NASA's partnership with GSUSA. GSUSA represents over 3.7 million girls, including 2.8 million girls ages 5-17, and close to 1 million adult members. The organization's structure (headquarters, councils, and troops) allows for national, regional and local involvement.

Solar System Community Nights Kits Navigator is participating in the GSUSA's adoption and dissemination of a dozen public-friendly kits to GSUSA councils around the country. Consisting of a tri-fold and NASA mission/exploration information, Navigator's "PlanetQuest" kit features a thematic tri-fold telling the history of the search for another Earth. Each of the 317 councils in the United States will receive a kit and be asked to sponsor several events using the kits with troops in their regions.

Training and Workshops Training Girl Scout leaders to effectively use education and outreach materials is also essential. Navigator Public Engagement will partner with SSE in the annual "National Train the Trainer" workshop programs aimed at making science exciting and fun. Navigator Public Engagement will also develop regional workshops and work with Campus Scouts (older Girl Scouts) to link troops to Navigator's resources.

Alignment to NASA Goals

The Girl Scout initiative aligns with the following NASA strategic goals and objectives:

	Goal	Objective				Goal	Objective	
	6	6.1	6.2	6.3	6.4	7	7.1	7.2
Meets	✓	✓	✓			✓	✓	✓

These activities will allow Girl Scout councils to "translate and deliver engaging NASA content" (objective 7.1) and "improve science literacy by engaging the public in NASA missions and discoveries" (objective 7.2). NASA's goal 6 is also addressed indirectly as these activities will "improve student proficiency" and "motivate K-16+ students."

Budget/Resources

Navigator E/PO will commit a full time Navigator staff person, targeted resources related to internet development and support, and support from community college, minority university and informal education staff coordinators to developing its Girl Scouts Initiative. Over the next three years, a total of approximately \$260,000 (including labor) is budgeted for these activities.

2.3 SOLAR SYSTEM AMBASSADOR PROGRAM

Description of Program

The Solar System Ambassador Program works with highly qualified and motivated volunteers across the nation. Volunteers are asked to organize and conduct public events that communicate exciting discoveries and events in space exploration through informal education venues such as libraries, museums, and planetariums, but also through non-traditional forums, such as Rotary Clubs and mall displays.

There are nearly 300 Ambassadors competitively selected from all 50 states (and Puerto Rico). Ambassadors are space enthusiasts, K-12 in-service educators, retirees, community college teachers, and members of the general public interested in providing greater service and inspiration to their local communities.

Though the Solar System Ambassadors Program began its focus on solar system exploration (with missions exploring Jupiter, Saturn, Mars, asteroids, comets, and the Sun), Navigator will take the Ambassadors outside of the solar system and introduce them to the missions and technology looking for planets beyond our solar system. Navigator has already directly trained dozens of Ambassadors about Navigator missions and armed them with the latest information and presentations with which to engage the public. Annual meetings of the ambassadors, additional training workshops, videoconferences, teleconferences and newsletters will allow Navigator to expand the reach of this initiative.

Alignment to NASA Goals

The Solar System Ambassador program aligns with the following NASA strategic goals and objectives:

	Goal	Objective				Goal	Objective	
	6	6.1	6.2	6.3	6.4	7	7.1	7.2
Meets						✓	✓	✓

Solar System Ambassadors work effectively to “engage the public in shaping and sharing the experience of exploration and discovery” (goal 7), to “translate and deliver engaging NASA content” (objective 7.1), and to “improve science literacy by engaging the public in NASA missions and discoveries” (objective 7.2). The test of “as only NASA can” is met with the effective use of NASA content and Navigator exploration themes and missions supporting an interested, leveraged community.

Budget/Resources

The Solar System Ambassador Program is managed at JPL with full-time dedicated staff. Navigator will provide partial funding to this office, as well as training resources, links to PIs and engineers, and other connections to other Navigator outreach pipelines. Navigator has budgeted \$113,000 over the next three years in support of this program (including Navigator E/PO workforce and materials).

2.4 COSMIC ORIGINS EXHIBIT

Description of Program

The National Science Foundation recently awarded the Space Science Institute a grant to develop a traveling exhibition on the search for cosmic origins. The Institute proposed that the exhibit be about 3,000 square feet, interactive, updateable, and that it be organized around three interrelated areas: *Star Birth*; *PlanetQuest*; and *Search for Life: Are We Alone?* The core of the Institute's proposal was to bring research from NASA's Origins Program to the public.

Based on program research, Navigator E/PO will guide the development of interactive visualizations for the exhibit and contribute to the overall storyline. The PlanetQuest area will engage visitors in the hunt for planets of all sizes, including those that may be in habitable zones around other stars. Current technology allows us to find only very large planets. However, this exhibit area will explore other technologies that may be developed by scientists for finding smaller, Earth-like planets that might harbor life. One goal of this area may be to demonstrate that many space phenomena can only be understood from indirect observations. Because of the dynamic pace of discovery in this area, Navigator envisions an ongoing role in keeping the PlanetQuest exhibit up-to-date with extrasolar planet discoveries, an approach modeled after the Navigator Program's successful website.

The exhibit will begin a three-year tour to nine host museums and science centers in early 2005. A second three-year tour is also planned for 2008. The Association of Science Technology Centers (ASTC) will manage the exhibit's national tour. In addition to the exhibit, the project includes workshops for educators and docents at host sites, as well as a public Web site that will use exhibit content to delve deeper into Origins research. Current partners in the *Cosmic Origins* project include ASTC, several NASA missions (Navigator, SIRTf, and Kepler), the SETI Institute, TERC, the New York Hall of Science, the Lawrence Hall of Science, the Denver Museum of Nature and Science, and the Space Telescope Science Institute. In addition to the NSF grant, the project is supported by NASA and various in-kind support from the project partners.

Alignment to NASA Goals

Navigator's participation in the Cosmic Origins Exhibit aligns with the following NASA strategic goals and objectives:

	Goal	Objective				Goal	Objective	
	6	6.1	6.2	6.3	6.4	7	7.1	7.2
Meets						✓	✓	

By bringing the story of stars, planets, galaxies, and *the search for life* alive, the museum exhibit and the interactive visualizations align with NASA's strategic Goal 7 (engaging the public in shaping and sharing the experience of exploration and discovery) and more specifically, objective 7.1, (improve the capacity of science centers, museums . . . to

translate and deliver engaging NASA content). Also, the overall project and all of the exhibit's components will be aligned with the National Science Education Standards, e.g., for grades 5-8: science as inquiry (what sorts of experiments might be designed to detect life?) and physical science (e.g., light interacts with matter and consists of visible, infrared, and other types of radiation) and Science and Technology.

Budget/Resources

Navigator E/PO has committed \$150,000 in direct contract support of the Cosmic Origins exhibit through 2004. In addition, Navigator staff will continue to invest limited time and resources in providing input, science content, and exhibit ideas that capture the most compelling and important aspects of Navigator technology, science, and missions, and which have the greatest possibility to capture the imaginations of young families and other museum patrons.

2.5 THE PBS/NOVA ORIGINS SERIES

Description of Program

Over the next two years, a major PBS/NOVA television series called *Origins* will be produced for national broadcast. A national outreach initiative will also be developed in concert with the series. This will be the first major PBS project to explore the cutting-edge scientific story of the evolution of our universe as a living cosmos. The series will contain the following four one-hour segments: Birth of the Universe (the story of how structure arose in the universe); Home (the story of the birth of the Earth and the origins of life); An Unlikely Eden (the story of how life may have first emerged); and Are We Alone? (the story of the hunt for planets and the search for life in the universe).

In addition to the television series, a significant outreach program is being developed and managed by the Pacific Science Center in Seattle and involves significant support from NASA's Office of Space Science. The education and outreach effort will take advantage of the fact that the series covers a number of scientific disciplines by using an integrated approach that focuses on the underlying concept of: "What is the evidence for" Two general topics of investigation are 1) electromagnetic energy, and 2) the fossil record (how do we know about the history of life on Earth?).

Five types of outreach programs will be produced:

1. Museum-based programs (including two-hour classes and science demonstrations)
2. Community-based programs (for use at YMCAs, libraries, parks, etc.)
3. Teacher Education Supplement (integrated into middle school earth science and the research-based science curriculum FOSS astronomy units)
4. A Web-based Search Engine
5. Citywide Events (immersion events to be held at ten select science centers across the country)

Navigator Public Engagement will support the production and outreach efforts by 1) providing scientific support to the film series production in the form of access to scientists, research, animations, and visualizations, and 2) leveraging its existing education and outreach programs to support the planned suite of events and activities, and to create additional targeted events to extend the reach of the program. Possible additional activities include star parties and demonstrations with Navigator Night Sky Network partners, workshops and lectures from Navigator scientists, and select local activities involving educators and students. Working with the Pacific Science Center and other Origins missions, Navigator Public engagement will create a program to support and extend the existing menu of planned outreach initiatives. All activities will be coordinated with the Pacific Science Center.

Alignment to NASA Goals

Support of a national media event which focuses on the big questions of “discovery” and of “life” which Navigator, in part, seeks to address, provides NASA with a unique opportunity to “engage the public in shaping and sharing the experience of exploration and discovery with exciting and visually appealing material.” (Goal 7)

	Goal	Objective				Goal	Objective	
	6	6.1	6.2	6.3	6.4	7	7.1	7.2
Meets						✓	✓	✓

The possibility of connecting scientists and their work to the public, families, and students in a meaningful and entertaining way also creates wonderful opportunities for inspiring the next generation. The PBS series has the potential to draw the attention of millions of viewers to the story of Origins and to lay the ground-work for a national dialogue involving many communities and organizations around the country.

Budget/Resources

The primary Navigator resources for this effort will come from existing partnerships described elsewhere in this plan, including the Night Sky Network, the Girl Scouts, the community college initiative, and Research Experiences for Minorities initiative. A total of \$40,000 (including Navigator workforce) has been budgeted to support specific visualizations and regional events tied to the national broadcast.

2.6 MUSEUM VISUALIZATIONS, MODELS, AND PLANETARIUM SHOW

Description of Program

Navigator Public Engagement is investing in the development of museum-quality exhibits and visualizations to carry the PlanetQuest story to more informal education venues. Some of the projects in the works include:

- **PlanetQuest Kiosk:** Navigator E/PO developed the software for a permanent PlanetQuest kiosk recently installed at The Keck Visitors Center at Mauna Kea. It features the Keck Virtual Tour and the Interferometry Demo created for the

PlanetQuest website. Visitors to the center can now take a virtual tour of the Keck Interferometer and try to find the fringes using a virtual interferometer. The center receives about 100,000 visitors a year.

- **PlanetQuest 3-D Exhibit:** The Navigator program has partnered with Provision Interactive Technologies, creators of a unique visualization technology called Holovision. Holovision delivers 3D projections similar to 3D IMAX films, but without the need for 3D glasses. These units have already been used to display interactive models of the SIM spacecraft and extrasolar planets at the American Astronomical Society and will be used again at the JPL Open House. Negotiations are under way for creating permanent installation of Navigator Holovision kiosks at various science museums throughout the country.
- **Planetarium Show: The Search for Another Earth** Another key element of Navigator’s ability to engage the public is the development and creation of a planetarium show that can generate more excitement about (and context for) the quest for life in the universe. Navigator Public Engagement will develop a program focusing on “The Search for Another Earth,” and featuring compelling visuals and clear science content. Discussions have been initiated with Dr. William Gutsch and Sullivan Productions (producers of the upcoming Ring World show for Cassini). Navigator will also encourage use of the show in community colleges, over a third of which have planetaria.

Alignment to NASA Goals

Navigator’s museum and planetaria products align with the following NASA strategic goals and objectives:

	Goal	Objective				Goal	Objective	
	6	6.1	6.2	6.3	6.4	7	7.1	7.2
Meets						✓	✓	

These activities meet NASA’s strategic Goal 7 (engaging the public in shaping and sharing the experience of exploration and discovery) and more specifically, objective 7.1 (improve the capacity of science centers, museums . . . to translate and deliver engaging NASA content).

Budget/Resources

Navigator E/PO has committed \$40,000 in development costs for the PlanetQuest 3D exhibit in 2004 and allocated additional funds for the development of a planetarium show in 2004 and 2005. Also, Navigator staff will continue to contribute time and resources to provide input, science content review, and exhibit ideas for these efforts.

3.0 NAVIGATOR PUBLIC OUTREACH

“It may not be planetary exploration the way the folks on Star Trek’s Enterprise do it, but for the moment, PlanetQuest is as close as we’ll get.”

–Christian Science Monitor

“Is Earth the only planet that is home to forms of life? NASA would like to discover the answer to that huge question. PlanetQuest is the site with details on just exactly how they plan to explore that exciting possibility.”

–Houston Chronicle

“This site–Planet Quest–is the greatest! Its going to take months to go through it all–and its all too good to skip anything. Thank you NASA for giving the public such great ways to learn about science today.”

*–From the PlanetQuest mailbag
Oren Benedic, St. Rose, LA*

PUBLIC OUTREACH

The primary goal of Navigator's effort in public outreach is to reach the majority of audiences where they are; in their daily lives outside of special situation such as schools, museums, or science centers. This area is traditionally the domain of the mass media such as television, news print and talk radio. These media are outside the scope of this plan. However, even after the break of the dot-com enthusiasm, the Internet continues to be the most rapidly growing information source for the attentive public. Navigator has chosen to develop its Internet presence into the main "pull-medium" for distributing informational and educational products, and to create communities to enhance the audience experience and their involvement in the quest for life.

Sidebar: PlanetQuest – the “go to” site for extrasolar planets

* * * * *

"New Scientist" magazine online, August 2002

NASA and JPL's PlanetQuest is an excellent site about extrasolar planets - planets outside our own Solar System. Find out about the historical and astronomical background to the search for new worlds, and the technical challenges that astronomers must overcome.

There's an emphasis on NASA's work, of course, with extensive coverage of missions from the ground-based Keck Interferometer in Hawaii to the future Terrestrial Planet Finder (TPF). The TPF isn't even expected to launch until 2012, but may take the form of a squadron of free-flying space telescopes which will combine their signals to examine extrasolar planets as small as Earth.

The "New Worlds Atlas" documents the planets which have been discovered so far, telling how and when they were discovered, and what their characteristics are. There are no maps of these planets yet - that will have to wait for technology beyond even the Terrestrial Planet Finder!

The site . . . makes extensive use of animations but they are optional rather than required - just as it should be! The multimedia section provides a virtual tour of the Keck Observatory, 3D simulations, animations, and videos; you'll need at least some of the Flash, RealPlayer, QuickTime, and Cult3D plug-ins to see them. A set of Educator Resources in Adobe Acrobat format may be useful for teachers and students.

A selection of links to other sites completes what is an excellent resource for anyone interested in space and astronomy.

3.1 INTERNET INITIATIVES

Description of Program

In accordance with the dynamic pace of discovery in the field of extrasolar planet observing, the approach to Navigator's Internet presence is a continuously updated news format that presents accurate information combined with compelling interactive experiences. All initiatives rely on the expertise of project personnel to provide technically accurate information presented in a format that makes the material relevant and accessible to the audience. The key to achieving this is partnering science and technology understanding with graphical presentation skills and journalistic insight. The Internet will also serve as a high-volume, low-cost distribution mechanism for electronic versions of Navigator educational products.

Creating the brand concept of "PlanetQuest" as the Internet presence for the Navigator program and in a larger sense for the search for life outside our solar system has proven to be a breakthrough in establishing the relevance of the search for extrasolar planets with the Internet audience. The brand label is intuitively recognized by the audiences and allows for inclusion of activities that belong thematically and by content in this area but might not be organizationally within the Navigator program. This has allowed us to present together material that is related in the public's perception but might be separated by NASA organization.

In the first phase of development, PlanetQuest (<http://PlanetQuest.jpl.nasa.gov>) has focused on creating an integrated and thematic website geared toward the general public. Its threefold purpose is to:

- serve as source of current *news and information* about Navigator projects and the search for extrasolar planets;
- provide a complete, visual *database* of all new planet discoveries; and to
- give access to *background material* on the Navigator missions, technology and science.

The ultimate goal is to make the PlanetQuest the "go-to" destination in the field of extrasolar planet studies. We aim to reach this goal by taking advantage of the full range of possibilities for using online multimedia to tell the Navigator story and engage users at an interactive, visceral level. We realize the need for constant maintenance and content generation. A new top story every week and ongoing development of multimedia ensures that users will discover new content every time they visit the site. Users are enticed to check in regularly in order to keep track of the unfolding Navigator story.

The effectiveness of the site's thematic, news-oriented approach has been demonstrated during its first two years of operation. PlanetQuest has won 20 national awards, more than quadrupled traffic for Navigator sites, and attracted widespread media coverage. Articles or reviews about the site have appeared in the following outlets: CNN, Science Magazine, Natural History Magazine, New Scientist Magazine, Discover Magazine, and The Christian Science Monitor. More recently, the site has been recognized with an

“A+” award from Education World, and has been ranked by Google as the number one Internet site for extrasolar planets (out of more than 30 sites).

A range of tracking and analysis tools allows us to closely follow traffic patterns on the site. Navigator will use this data to guide and inform future development. At this point it is clear that future growth will depend on a continued infusion of current content and news. In February 2003, the monthly number of unique visitors exceeded the 60,000 mark with a strongly rising trend.

The second phase of development of the PlanetQuest website, already underway, seeks to greatly expand on the reach of the audiences and the media employed. The expansion will focus on the following areas:

3.1.1 Investment in an Integrated PlanetQuest Website

Mission Sites Each key Navigator mission has a separate site and home page that is fully integrated with the PlanetQuest site, while preserving the mission's unique identity. Navigator web development staff continuously maintains these sites with the direct participation of project staff members.

Professional Resources Working closely with project engineers and scientists, Navigator has developed an “Engineers & Scientists” section of the Internet presence (accessible through a button on the main page). This site is a repository for technical documents, papers, and science presentations related to the mission. The material is continually updated through close, ongoing communication with project personnel.

3.1.2 Investment in Enhanced Interactivity

PlanetQuest 3-D Atlas This major Internet initiative, completed in FY-03 provides amateur astronomers and the public with a continually updated database of extrasolar planetary discoveries. It will include a state-of-the-art virtual simulation of the search area extending to 500 light years from Earth, with fly-through navigation controls and individual planetary systems identified. An atlas of downloadable and printable sky maps, identifying the location of each planetary system in the night sky, was also added in 2003. Already available is thumbnail information on each planetary system, including statistics on mass, orbits, coordinates, method of discovery and links to related scientific papers.

Interactive Modules A key Internet initiative is the ongoing development of self-contained interactive modules that allow users to engagingly experience the science and technology of the Navigator Program. Each of these multimedia features reaches a wide audience through presentation not only on the PlanetQuest site, but on the JPL Home page and NASA Portal as well. Modules to be released in the next fiscal year, at the approximate rate of one every other month, include an "Interstellar Trip Planner," "Formation Flight Game," "SIM Tutorial," and the "Technology Enables Discovery Timeline."

Interactive Webcasts Designed for up-coming media or mission events, webcasts form a crosscutting component of Navigator Internet development, driven by mission milestones such as launches, technology breakthroughs and discoveries, or planetary events such as the Venus transit. The format was established in the Navigator's pilot webcast of 2002, titled "Earth Day Webcast: The Search for Habitable Planets." A panel of JPL scientists was convened, along with a moderator, and received questions in real time from students, teachers and the public in an informal, talk-show setting. Each future webcast will revolve around a particular subject or theme, such as early Keck Interferometer science results. Webcasts serve two strategic purposes in the plan: (1) directly involving scientists and engineers in public outreach; and (2) giving students and the public access to the people behind the missions. A webcast focused on the Venus transit is planned for March 2004. Students and teachers will learn about the 2004 Transit of Venus during a live preview broadcast from JPL. This interactive discussion will focus on what the Venus Transit can teach us about the search for planets beyond our solar system

3.1.3 Electronic Educator Resources

Navigator will also continue to make educational activities easily available through the web and to offer additional web components for each print-form educational product. Taking as an example an existing resource, the Navigator program's award-winning "Taking the Measure of the Universe" poster, the web component will offer animations that further illustrate the exercises and science concepts that form the basis for the poster's educational activities. This direction is confirmed by the interest in the pdf-format of the poster material. In FY2003, this pdf-file was downloaded more than 100,000 times.

3.1.4 Night Sky Network Hub

The Internet will provide an electronic hub for the Night Sky Network enabling members worldwide to communicate with each other and with the project, and to send and receive news and event information. The website will exist within the PlanetQuest domain and serve as a vital resource for amateur astronomers and others who wish to join the network. The Internet Hub is described in more detail in section 3.1 of this plan.

Alignment to NASA Goals

Navigator Internet initiatives are well aligned with NASA's mission to inspire the next generation of explorers "as only NASA can." Engaging and capturing the imagination of our audiences will open the minds of many considering careers in science and technology. Navigator's internet initiatives align with the following NASA strategic goals and objectives:

	Goal	Objective				Goal	Objective	
	6	6.1	6.2	6.3	6.4	7	7.1	7.2
Meets						✓		✓

The PlanetQuest website aligns well with NASA's strategic goal 7, to "engage the public in shaping and sharing the experience of exploration and discovery." More specifically, these activities align with objective 7.2 as PlanetQuest seeks to "improve science literacy by engaging the public . . . through . . . the internet." Navigator presents content that is unique to NASA with compelling interactive technologies and innovative educator resources.

Budget/Resources

Navigator has a full-time Internet architect dedicated to developing its presence and resources on the Internet. The architect is responsible for the overall concept of the site and oversees and directs the technical development. Graphic design and code development is subcontracted. The Internet Architect is assisted by an academic part-time position. Starting in FY2005, we expect to add an additional position dedicated to ongoing content development. Including this workforce, Navigator has budgeted \$655,000 in support of Internet infrastructure and interactivity through FY 2005.

3.2 MEDIA SUPPORT INITIATIVES

Navigator Public Engagement will work to identify and support media opportunities and initiatives in the following ways:

- **Filmed Archival Interviews:** Navigator Public Engagement is filming key science and engineering personnel in order to provide “story elements” (as well as outreach speaker support) for programming and press. All SIM PI’s have been filmed talking about their science and discoveries, and about why SIM is important. Another initiative, the SPHERES flight experiment, designed in part by students and faculty at MIT, may provide another media support opportunity in the future. The TPF-funded experiment (DARPA is also a major funder) is a demonstration of multiple spacecraft formation flying in a zero-gravity environment and will fly an experiment on board the International Space Station.
- **Visualizations to Support NASA Space Science Updates and General Press Releases:** Navigator E/PO will continue to support NASA with visualizations to accompany press conferences, such as the 55 Cancri animation produced to accompany Geoff Marcy’s June 2002 SSU and the visualization to accompany the May 2003 press release on the first science results from the Keck Interferometer. (See also section 4.3.)
- **Incorporation of Popular Press Stories into Outreach Materials:** Navigator is also working to include popular press stories in certain outreach materials and kits. An example of this is the May 2003 feature story in *Sky & Telescope Magazine* called *Interferometry Comes Of Age* which features profiles of all the Navigator missions. Reprints of this article are being included in kits for Solar System Ambassadors and Night Sky Network amateurs.

Alignment to NASA Goals

Navigator’s Media Support Initiatives align well with NASA’s strategic goal 7, (engage the public in shaping and sharing the experience of exploration and discovery) and objective 7.2 (improve science literacy by engaging the public in NASA missions and discoveries, . . . through such avenues as . . . mass media . . .).

	Goal	Objective				Goal	Objective	
	6	6.1	6.2	6.3	6.4	7	7.1	7.2
Meets						✓		✓

Budget/Resources

Navigator has an assigned media representative from the JPL Office of Communication responsible for press releases and media contact. Navigator also has experienced film producers and a television studio at its disposal. Including this workforce, Navigator has budgeted \$229,000 through FY 2005 for these activities.

4.0 CROSSCUTTING ACTIVITIES

4.0 CROSSCUTTING ACTIVITIES

Crosscutting activities are those which impact more than one of the programmatic areas of formal education, informal education, and public outreach. Ranging from management, to materials, to evaluation, these activities are critical to the program's ability to deliver a successful and innovative education and outreach program and to achieve its vision and goals.

Crosscutting activities include:

- 4.1 Participation of Scientists and Engineers
- 4.2 Management and Communication
- 4.3 Visualizations and Animations
- 4.4 Input and Evaluation

4.1 PARTICIPATION OF SCIENTISTS AND ENGINEERS

As the current generation of NASA explorers, Navigator Program scientists and engineers have a unique opportunity to impact scientific and technological literacy in America and to inspire the next generation of explorers. Navigator E/PO will continue to work to involve and engage the science and engineering communities of the Navigator Program in all aspects of its education and outreach programs and materials as well as to provide support to these communities in their own education and public information initiatives.

The preceding three chapters outlined an Education and Public Outreach program that is rich in scientific and technical content and that is tailored to the needs and interests of our audiences. The implementation of this program depends to a large extent on the active participation of a number of scientists and engineers bringing the search for life outside our solar system alive in the audience's imagination. Scientists and engineers will have critical roles in all of the outlined activities.

The dependence on the active involvement of scientists and engineers in the Navigator EP/O Program creates a potential risk due to constraints on availability, interest, and funding. The following section outlines activities under development aimed at building and maintaining a sufficiently large pool of engaged scientists and engineers at JPL, at industry partners, and at collaborating research institutions.

In the context of the Navigator Program it is important to emphasize the role of engineers and technical professionals who might not see themselves as scientists. Some of the most important activities within Navigator (particularly in the near-term) are technology development areas that require a large pool of talented professionals. This talent pool is a

particular asset as it widens the window of future careers that students might be interested in far beyond basic research.

4.1.1 Involvement of the E/PO Scientist

Currently, NASA has selected only one science team within the Navigator Program. The Space Interferometry Mission science team consists of ten research groups led by a principal investigator and five mission scientists. Including all co-investigators, this team contains 86 researchers throughout the nation and internationally. Over the next few years we expect that NASA will form similar teams for other Navigator missions. As of this writing, the Navigator Program also includes the Science Working Group for the Terrestrial Planet Finder, the Shared Risk Science teams for the Keck Interferometer, the scientists working on LBTI, and, of course, the scientists at the Michelson Science Center, JPL and the industry partners for the Navigator Program.

Navigator E/PO's interaction with the SIM science team will be a model for collaboration and support of future Navigator mission science teams. Dr. Guy Worthey at Washington State University in Pullman, WA has been competitively selected by NASA to be the EP/O scientist on the SIM science team.

In his role as a full member of the science team, Dr. Worthey has the unique role of bringing EP/O experience and content to the science team and in turn to connect his colleagues to the overall efforts being undertaken in the program. Dr. Worthey is the focal point for the interaction with the science team with regards to EP/O. He advises the Navigator EP/O team on the overall implementation of the plan and focuses activities within the science team in this area. The Navigator EP/O team holds regular meetings with him and additional members of the science team to review the overall activities of the plan and to strategize on future activities.

4.1.2 A Science Team EP/O Fund

An example of an initiative originated by the SIM EP/O scientist is the creation of a separate funding pool (a venture fund for new projects) for EP/O activities within the SIM science team. While Navigator expects the majority of science team members to be engaged in activities led by the Navigator EP/O Program, it is also important to support local or regional initiatives that emerge out of interests or associations that the science teams may have in their region of the country. This fund will allow a larger number of researchers to gain first-hand experience with EP/O activities and will generate excitement and involvement among the science team peers. The program also has the potential to generate many innovative projects. Projects with the potential for national impact will be considered for integration as new elements in the larger program with substantially increased funds.

The EP/O funding pool for the SIM Science Team will be under the control of the SIM Outreach Scientist Dr. Worthey. It is our expectation that Dr. Worthey will work with the members of the SIM Science Team to identify the projects and individuals that will receive funding out of this pool up to a negotiated annual total. The actual distribution of

funds will be either handled through the regular funding mechanism for the SIM Science Team at JPL or through the SIM Outreach scientist directly as determined by mutual agreement. All funded EP/O projects will be required to report impact metrics in full compliance with NASA guidelines. The outreach scientist will be responsible for collecting these metrics.

For the next three years, the funding for the science team EP/O fund will ramp up with the following profile to a steady funding level reached in FY 2005: FY 2003 – \$50,000, FY2004 – \$100,000, FY2005 – \$150,000.

4.1.3 Coordination with the MSC Science Community Outreach Team

In 2003, the Michelson Science Center created a science outreach group to act as a liaison to the science community over the next several years to support MSC's growing role in mission science operations. The current plan for this team is to hire up to 2.5 FTE's to engage the science community, answer questions, pro-actively engage scientists, and create a website tailored to the science community. Navigator Public Engagement will coordinate with this team and support these efforts through regular communication as well as specific targeted activities such as the MSC Educational Awards (see section 1.2.2)

4.1.4 Building Support for EP/O Activities: Navigator Ambassadors

A project on the scale of the Navigator Program, with hundreds of technical professionals distributed over a large part of the country, provides an opportunity to develop national reach; but it also comes with built-in challenges related to effectively supporting such a large group. Several steps can be taken to create a motivated cadre of ambassadors, "Navigator Ambassadors," capable of representing the program and engaging the public and students.

A Database of Professionals

Navigator Public Engagement is developing a database of participating technical professionals who have an interest and/or prior experience with EP/O activity. This database will be a resource for finding role models and inspiring stories, and for connecting individuals to appropriate activities, events, or programs.

Speaker and Activity Support

The Public Engagement team will act as the education broker/facilitator for the Navigator scientific and technical communities. Navigator Public Engagement will coordinate speaking events related to all of its initiatives and will provide effective and engaging materials for the speakers to use. Navigator will also offer any training that might be needed in the use of these materials. For example, the presentation resource kits originally developed for amateur astronomers in the Night Sky Network contain a rich set of activities that can be integrated into a other presentations or that can be used to create inquiry-based activities in informal settings. Effective use of these activities will allow

Navigator Ambassadors to connect in a more engaging and lasting way to their audiences.

Forums for Expanding Relationships

Several existing forums provide valuable platforms for expanding relationships with the scientific and technical communities, including:

- **Mission Team Meetings and Reviews** – Navigator E/PO team members will continue to meet regularly with a core group of mission representatives, including project managers and others, to review progress on initiatives, to review educational and outreach products for scientific accuracy, and to share the on-going stories and examples of how technology is making discovery possible.
- **Mission Science Team /PI Meetings** – The mission PI's and science teams represent a strong network of individuals located throughout the country who are able to carry the educational activities and stories to various communities. Navigator E/PO team members will continue to participate in key mission meetings for SIM, TPF, Keck, and LBTI through discussions, presentations and pre-planned initiatives such as interviews, focus groups, and review committees for new initiatives. Involving scientists in reviews of educational and outreach products for scientific accuracy is another important element of successful outreach. PI's who have received grants for education and outreach will be encouraged to coordinate their efforts with larger goals of Navigator E/PO.
- **Science Conferences** – Support of major science conferences such as the American Astronomical Society (AAS) meetings, the Division of Planetary Sciences (DPS), the Society for Optical Engineers (SPIE), and others are important venues for the continued development of key E/PO initiatives, such as the Night Sky Network initiative and for getting more people involved in E/PO.

4.2 MANAGEMENT AND COMMUNICATION

Management and communication activities include oversight, plans, reviews, budgets, and reports to management, project teams, scientists and NASA, and general communications. Management and communications activities include the following specific sets of activities:

4.2.1 Plans, Reviews, Budget, and Reports

- **Budget Planning, Management, and Control** Each year, a Work Breakdown Structure and task plans are created for Navigator E/PO. Budgets are reviewed and managed monthly and adjustments made as necessary in order to maintain sound fiscal management.
- **Plan Reviews** Regular plan reviews will be held to assure that progress is being made, and that program goals and milestones are being met. Reviews also offer an opportunity to assess the need for changes in direction, emphasis, or resource allocation.
- **The NASA Education Evaluation Information System or "NEEIS" (formerly known as EDCATS)** Navigator maintains compliance with NASA's tracking and reporting system for educational impact by entering all activities and product statistics into NEEIS on a regular basis.

4.2.2 Communications

As a part of JPL's Office of Communication, Education and Outreach, Education Section, and Astronomy and Physics Directorate, Navigator Public Engagement is an active participant in numerous meetings and presentations. These forums often allow the sharing of "best practices" and other information critical to maintaining an effective program. Other communications vehicles and audiences include:

- **NASA Quarterly Reviews (GPMCs)** Progress toward implementation of the Navigator plan and highlights of recent activities is presented to NASA as a part of the Navigator Program GPMCs four times a year.
- **Astronomy and Physics Division, OSS** Navigator Public Engagement is also responsive to NASA's Astronomy and Physics Division, including its Program Executive and Program Scientist, and provides regular updates and assessments throughout the year.
- **OSS Education Director and Staff** Navigator works closely with the Office of Space Science Education Director and staff in the development of its strategic goals and supports the office through participation in regular OSS Education

Council Meetings. Navigator Public Engagement also coordinates through this office with the recently established Education Enterprise, Code N.

- **NASA Origins Education Forum** Navigator participates actively in the Origins Education Forum through regular telecons, annual meetings and tag-ups, and strategic planning sessions. Navigator also provides regular activity reporting. The forum provides a unique platform to collaborate with other Origins missions in order to extend the impact of program initiatives.
- **General Communications–Navigator E/PO Headlines** Navigator publishes a monthly email newsletter called “Navigator E/PO Headlines” to a list of over 500 names, including NASA officials, JPL education and outreach personnel, all mission personnel, industry partners, and E/PO partners. The headlines present highlights of monthly activities and the latest Navigator and planet-finding news.

4.3 VISUALIZATIONS AND ANIMATIONS

Visualizations created to support the emerging story of the search for another Earth are central to many of Navigator and NASA’s goals and objectives, particularly in the ability to “inspire the next generation of explorers,” and to “engage the public in shaping and sharing the experience of exploration and discovery.”

- **Videos** Introductory videos telling the “story of the search for another Earth” will allow students, teachers, and the public to connect to the excitement of the journey of discovery, and set the stage for speakers to introduce their own individual talks and discussions. The science and technology employed by SIM, TPF, Keck and LBTI will provide visual content for the unfolding story of Navigator missions. Navigator E/PO has also begun to compile documentary style video interviews with scientists and engineers for use as web “spotlights,” and in other initiatives. Continuing to put a human face on NASA missions will help contribute to “inspiring the next generation of explorers.”
- **Animations** Whether for the web site, or in support of NASA Space Science Updates, or in support of television programs like the PBS Origins series, exciting animations will help Navigator fill the need to visually tell a story that will be many years in the making, and one in which actual science images will be limited.
- **3-Dimensional Universe and Constellation Maps** New constellation maps linking the extrasolar planets to the night sky is another Navigator initiative which will serve a number of communities, ranging from students and teachers, to amateur astronomers, to university students. An online version of the “planet-searching neighborhood” will allow the user to interact with this world of new planets.

4.4 INPUT AND EVALUATION

Navigator Public Engagement believes that evaluation should be integrated into the structure of each of its initiatives, and that the effectiveness and impact of its overall program must be regularly evaluated and measured. Programs have a better chance of succeeding when anchored to a clear statement of expected outcomes and a design that will allow these outcomes to be identified and assessed. Also, project stakeholders should be invited to participate in evaluation planning and implementation in order to enhance the effectiveness of the evaluation, to increase stakeholder commitment, and to improve the utilization of the results.

Navigator Public Engagement seeks input and evaluation on three levels:

1. **Community Input:** The creation of development, innovation and feedback processes that bring education and outreach experts, customers, and partners (including scientists) together to explore best practices, infuse new ideas, and provide feedback on existing materials. For example, the Educator Advisory Board of 24 educators in the Community College Initiative works with partners, students, and scientists to shape the best material for their audience. Another example is the nationwide Advisory Group of 15 amateur astronomers in the Night Sky Network Initiative. These and other partners provide input and linkages that enable Navigator to continually test its program assumptions and to manage for innovation.
2. **Overall E/PO Plan Evaluation:** Navigator Public Engagement has hired an outside evaluation expert to review its overall objectives, resources, and stated outcomes based on its evolving plan and on-going activities. Dr. David Drew, a recognized education specialist and evaluator and author of [Aptitude Revisited, Rethinking Math and Science Education for American's Next Century](#), has been engaged to evaluate the overall program effectiveness and to help design processes for input and review, to clarify assumptions and stated outcomes, and to establish ways to engage education experts and customers in achieving the goals of the overall program. Outcomes will be measured by the use of surveys and interviews with key customers, participants, and other key stakeholders. Both *process* and *outcomes* will be evaluated and measured.
3. **Program-Specific Evaluation:** Where feasible, Navigator E/PO allocates 10% of its individual program budgets for evaluating the impact and effectiveness of individual programs. For example, the Institute for Learning Innovation based in Annapolis MD is budgeted at 10% of the Night Sky Network initiative for amateurs. Navigator's formal and informal education programs will undergo annual assessment by the evaluators to determine the effectiveness of various initiatives based on the impact metrics contained in this plan, (as well as metrics agreed upon with key stake-holders as projects evolve), continued feasibility,

partnering effectiveness, and administrative ease. A key quality assurance metric will be the ability to meet the changing needs in the education communities. Navigator E/PO will also work closely with the Office of Space Science and the Origins Education Forum to identify areas for improvement and expansion.

Budget/Resources

Navigator Public Engagement's goal is to invest 8% to 10% of its total budget in input and evaluation. Navigator will spend approximately \$422,000 on input and evaluation in the next three years, including plan reviews, educator advisory sessions, and the retention of outside evaluators. An additional \$95k total is set aside for evaluation within the following projects: Community College Initiative, Navigator Research Experiences for Minorities, Night Sky Network, and the Solar System Ambassadors.

CONCLUSION

We shall not cease from exploration,
And the end of all our exploring
Will be to arrive from where we started
And know the place for the first time.

- T.S. Eliot

Less than a generation ago, the word “planet” referred to a rocky or gaseous body within our own solar system orbiting a star we call the Sun. Today, over a hundred other planets have been discovered orbiting other stars. Less than a generation ago, the speculation of life elsewhere in the universe was reserved for the realm of science fiction; today that speculation is being fueled spectacularly by science. *And what about a generation from now? How many planets will have been discovered? How much will we understand about the origins of stars, planets, galaxies, and of life itself? And most important, who will we be able to bring along into this journey of discovery? When the Terrestrial Planet Finder launches, a kindergartner today will be poised to make a decision about her college and career choices. What will she decide? Who will her role models be? Will she have the confidence and resources to make an informed decision?*

Building bridges to future teachers through community colleges (and through a more scientifically informed public in general) and nurturing a national network of amateur astronomy enthusiasts are new initiatives that Navigator Public engagement will pursue in order to further NASA’s goals. Involving scientists and engineers in all aspects of discovery and education is also a critical component of a future in which science and technology provide increasingly more powerful ways of exploring the universe. Developing meaningful research and mentoring opportunities for students and faculty in minority universities, creating compelling images and visualizations, finding new ways to allow technology help communicate the story, making *the search for another Earth real in the night sky* are all opportunities for widening the Navigator/NASA community. Building partnerships that extend and multiply resources, and collaborating with other Origins missions, can help ensure that Navigator E/PO can expand its reach.

While Navigator missions are poised on the threshold of **discovery**, Navigator Public Engagement is poised on the threshold of **opportunity**. This opportunity can be partially explained in the power of the creation of a story of exploration and technological discovery, a story of telescopes and scientific ingenuity, a story that will engage students, teachers, parents, and the public— a story that will rise to the challenge of “inspiring the next generation of explorers as only NASA can.”

APPENDICES

- A. Navigator Mission Milestones**
- B. Roadmap of Programs**
- C. Budget**
- D. Organization Charts**
- E. Biographies of Key Personnel**

Appendix A: Navigator Mission Milestones

MISSION MILESTONES				
	Mission	Near-term (FY03-FY05)	Mid-term (FY06-FY10)	Long-term (FY11-FY 20)
	Keck	<ul style="list-style-type: none"> • First fringes from combined telescopes • Science Program starts • Achieve starlight suppression (nulling) • Detection of hot Jupiters 	Detect exozodi dust	
	SIM	<ul style="list-style-type: none"> • Demonstrate ability to measure fringes to picometer • Demonstrate transfer of picometer knowledge between baselines 	Launch (2009)	<ul style="list-style-type: none"> • SIM data determines planetary orbits • SIM detects planets down to 3 Earth masses • Making sense of the SIM grid • SIM grid becomes astrometric reference frame • Create targets for TPF
	TPF	<ul style="list-style-type: none"> • Architecture downselect to 2 (2002✓) • Spheres flight test (2003) 	<ul style="list-style-type: none"> • Architecture downselect to 1(2006) • Resolution of TPF technology: Infrared spectra or visible spectra 	<ul style="list-style-type: none"> • Launch (2012-2015) • Science program (~2016-2021) • Find rocky planets with goldilocks orbits and giant protectors • Detect biomarkers
	LBTI	Achieve starlight suppression (nulling)	Begin surveys of nearby stars (2006-2013?)	

Appendix B: Roadmap – 1.0 Formal Education

KEY MISSION MILESTONES				
	Mission	Near-term (FY03-FY05)	Mid-term (FY06-FY10)	Long-term (FY11-FY 20)
	Keck	• Science Program/Nulling/hot Jupiters	Detect exo-zodi dust	
	SIM	• Demonstrate picometer measurement • Demonstrate baseline technology	Launch (2009)	• SIM detects planets to 3 earth masses • Create targets for TPF
	TPF	• Architecture downselect to 2 (2002✓) • Spheres flight test (2003)	• Architecture downselect (2006) • Resolution of TPF technology:	• Launch (2012-2015) • Science program (2016-21)/earth planets
	LBTI	• Achieve starlight suppression (nulling)	Begin surveys of nearby stars (2006-2013?)	

1.0	FORMAL EDUCATION			
	Program	Near-term (FY03-FY05)	Mid-term (FY06-FY10)	Long-term (FY11-FY 20)
1.1	Community College Education Initiative			
1.1.1	Linking to the Education Community	Work with advisory group to shape and develop educational materials; task group with early adoption and dissemination	Expand advisory group membership in order to allow other institutions invest in continuing development of materials.	
1.1.2	Partnerships for “active learning” materials, dissemination, and training	Develop “lecture tutorial” courses through partnerships with CAPERS and TYC21. Develop national conferences for Astronomy 101 workshops.	Work with other state and regional community college associations and community college faculty to refine and expand program. Expand the network of faculty able to participate, with target of reaching 50% of all community college astronomy courses in the U.S.	
1.1.3	A dedicated website for astronomy faculty and students	Develop a one-stop shopping community website for astronomy faculty and students with a variety of useful and practical features, products, programs, and professional development opportunities.	Continue to add innovative and useful features. Grow website as an effective community board, where the vibrant exchange of “teaching excellence” ideas continues to thrive and expand.	
1.2	Navigator Research Experiences for Minorities			
1.2.1	Consortium for Undergraduate Research	Support existing infrastructure by funding additional students and connecting Navigator scientists to mentoring.	Grow program to involve other sites around the country. Expand the network of faculty able to participate in programs. Involve more scientists/Michelson Fellows.	
1.2.2	Pilot Undergraduate Research Summer Program	Develop and implement TN State summer research program. Expand to include students and faculty from other minority institutions.	Based on evaluation outcome of pilot, expand program participation to involve students from a significant number of minority institutions. Link to JPL summer programs. Continue to seek out lesser-known partner institutions.	

Appendix B (cont'd): Roadmap – 2.0 Informal Education

KEY MISSION MILESTONES				
	Mission	Near-term (FY03-FY05)	Mid-term (FY06-FY10)	Long-term (FY11-FY 20)
	Keck	• Science Program/Nulling/hot Jupiters	Detect exo-zodi dust	
	SIM	• Demonstrate picometer measurement • Demonstrate baseline technology	Launch (2009)	• SIM detects planets to 3 earth masses • Create targets for TPF
	TPF	• Architecture downselect to 2 (2002✓) • Spheres flight test (2003)	• Architecture downselect (2006) • Resolution of TPF technology:	• Launch (2012-2015) • Science program (2016-21)/earth planets
	LBTI	• Achieve starlight suppression (nulling)	Begin surveys of nearby stars	

2.0	INFORMAL EDUCATION			
	Program	Near-term (FY03-FY05)	Mid-term (FY06-FY10)	Long-term (FY11-FY 20)
2.1	Night Sky Network			
2.1.1	Astronomy Clubs and PRKs	Design, pilot, and launch a platform for amateur astronomers and astronomy clubs to conduct education and outreach events.	Leverage improvements in technology, software, and equipment to expand participation by more amateurs and clubs. Tie in to mission launches, including Kepler	
2.1.2	Community Building, Professional Development	Support Night Sky Network through the involvement of scientists and workshops and training for amateurs.	Increase penetration to more clubs, with linkages to targeted communities. Evolve training materials to keep pace with technology and discoveries.	
2.1.3	Looking for Planets	Create platform for advanced amateurs to engage in real science and share their work with various targeted communities.	Create amateur science link to MSC. Promote findings and develop vehicles for recognition and support (internet, awards, scientist/NASA acknowledgement).	
2.2	Girls in Science- Girl Scouts	Work with SSE Forum to design events, workshops, and training. Support Community Nights Kit development and distribution.	Expand partner base to reach groups in every state. Reinforce and strengthen educational content with greater involvement of education community.	

2.3	Solar System Ambassadors	Build enthusiasm and excitement for planet-finding among core constituents in Solar System Ambassador program.	Expand Ambassador enthusiasts to all fifty states. Enhance outreach related to mission launches and link to launches, including Kepler (2007), SIM (2009), and TPF (2015).
Museum Exhibits and Alliances			
2.4	Cosmic Origins Exhibit	Advise on development of PlanetQuest area of exhibit. Develop workshop tie-ins to exhibit launch in 2005.	Support continued life of Origins exhibit in museums around the country. Host events at participating museums to tie to Kepler, SIM, and TPF launches.
2.5	PBS Origins Series	Leverage materials and events to tie-in to the 2004 broadcast of the PBS Origins series.	Utilize materials created for series, together with documentary footage to enhance on-going informal education initiatives.
2.6	Visualizations, Models, and Planetarium Show	Support existing platforms and loan-outs and invest in new materials and venues. Develop a planetarium show.	Distribute planetarium throughout U.S. Encourage use in community colleges with new lecture-tutorial programs. Engage Navigator Ambassadors around the country.

Appendix B (cont'd): Roadmap – 3.0 Public Outreach

KEY MISSION MILESTONES				
	Mission	Near-term (FY03-FY05)	Mid-term (FY06-FY10)	Long-term (FY11-FY 20)
	Keck	• Science Program/Nulling/hot Jupiters	Detect exo-zodi dust	
	SIM	• Demonstrate picometer measurement • Demonstrate baseline technology	Launch (2009)	• SIM detects planets to 3 earth masses • Create targets for TPF
	TPF	• Architecture downselect to 2 (2002✓) • Spheres flight test (2003)	• Architecture downselect (2006) • Resolution of TPF technology:	• Launch (2012-2015) • Science program (2016-21)/earth planets
	LBTI	• Achieve starlight suppression (nulling)	Begin surveys of nearby stars (2006-2013?)	

3.0	PUBLIC OUTREACH			
	Program	Near-term (FY03-FY05)	Mid-term (FY06-FY10)	Long-term (FY11-FY 20)
3.1	Internet Initiatives			

3.1.1	Investment in Integrated PlanetQuest Website	Complete integration of all Navigator mission websites into single PlanetQuest site. Host resources/presentations for project professionals.	Evaluate and improve features that allow the missions to “tell their story” while also refining the messages and science content related to the overall PlanetQuest story. Work to add “human dimension” to the story. Build support for mission launches, including Kepler (2007), SIM (2009), and TPF (2015).
3.2.2	Investment in Enhanced Interactivity	Complete 3-D Planetary Atlas, sky maps, and other state-of-art simulations. Refine webcast format for upcoming events.	Continue to invest in future technologies and to enhance the public’s access to data and “virtual” experiences. Make PlanetQuest the “go to” site for extra-solar planets.
3.1.3	Electronic Educator Resources	Work with educators and scientists to enhance the educational content of website	Continue to expand the capabilities to support compelling educational experiences with new and innovative tools and activities.
3.1.4	Night Sky Network Website	Develop the Planet-Finder hub as a vital resource for amateur astronomers and others who wish to participate in the Night Sky Network.	Continue to develop and improve the “hub” as a growing and vital community of enthusiasts. Assess participant needs satisfaction and review and incorporate “best practices” of other web-based communities. Create events for mission launches, including Kepler (2007), SIM (2009), and TPF (2015).
3.2	Media Support Initiatives		
3.2	Media Support	Work with media office to provide expanded support to upcoming media stories, including animations and supplemental information.	Provide enhanced media support and press kit information for mission launches, including Kepler (2007), SIM (2009), and TPF (2015). Work to leverage more “PlanetQuest” news stories into mainstream outlets.

Appendix B (cont'd): Roadmap – 4.0 Crosscutting Activities

KEY MISSION MILESTONES				
	Mission	Near-term (FY03-FY05)	Mid-term (FY06-FY10)	Long-term (FY11-FY 20)
	Keck	• Science Program/Nulling/hot Jupiters	Detect exo-zodi dust	
	SIM	• Demonstrate picometer measurement • Demonstrate baseline technology	Launch (2009)	• SIM detects planets to 3 earth masses • Create targets for TPF
	TPF	• Architecture downselect to 2 (2002✓) • Spheres flight test (2003)	• Architecture downselect (2006) • Resolution of TPF technology:	• Launch (2012-2015) • Science program (2016-21)/earth planets
	LBTI	• Achieve starlight suppression (nulling)	Begin surveys of nearby stars (2006-2013?)	

4.0 NAVIGATOR CROSSCUTTING ACTIVITIES				
	Activity	Near-term (FY03-FY05)	Mid-term (FY06-FY10)	Long-term (FY11-FY 20)
4.1	Participation of Scientists and Engineers			
4.1.1	Involvement of the E/PO Scientist	Form strong working relationships with PIs and science teams to extend reach of E/PO. Incorporate ideas into planning and implementation.	Continue to find ways to support, engage, and connect them to Navigator Public Engagement. Integrate mission milestones, particularly SIM and TPF launches into communications.	
4.1.2	A Science Team E/PO Fund	Form fund, create effective selection, distribution, and reporting mechanisms.	Evolve fund to include more Navigator mission science teams. Build on regional successes with national activities	
4.1.3	Coordination with MSC Science Community Outreach Team	Support science outreach efforts through regular communication and specific targeted activities such as the MSC Educational Awards	Expand educational opportunities through increased funding and integration of undergraduate support efforts. Involve Navigator Ambassadors in overall science outreach efforts.	

4.1.4	Building Support for E/PO: Navigator Ambassadors	Create database of professionals and E/PO activities. Develop and disseminate inspiring “speaker kits” and visual materials	Continue to expand network to include a wider pool of professionals. Connect regional interests to wider Navigator programs, such as Night Sky Network. Build and expand network of engaged Navigator Ambassadors around the country, increasing the footprint of the “PlanetQuest Story.”
4.2	Management and Communication		
4.2.1	Plans, Reviews, Budgets, and Reports	Develop and enact an effective planning and review process.	Demonstrate increasing levels of impact, and dollars wisely spent against all existing programs.
4.2.2	Communications	Continue to communicate plans and activities to management, project teams, scientists and NASA.	Demonstrate increasing levels of integration with mission goals and improvements in support from all key partners in Navigator E/PO.
4.3	Visualizations and Animations	Develop and disseminate high quality visualizations in support of Navigator missions and the “PlanetQuest Story”	Provide increasing levels of visual experiences to support the evolution of Navigator’s exciting technologies and to provide context to the increasing interest in the bigger questions surrounding “the search for another Earth”
4.4	Input and Evaluation	Invest in formal evaluation processes and experts to evaluate and measure the effectiveness and impact of all initiatives. Link education experts, customers, and partners (including scientists) to explore new ideas and best practices.	Continue to improve and evolve assessments and customer input. Demonstrate improvements in public engagement payload resulting from stakeholder input and meaningful assessment of outcomes.

Appendix E: Biographies of Key Personnel

W. Michael Greene

Michael Greene is the Manager for the Universe Theme Public Engagement effort at NASA's Jet Propulsion Laboratory. The Universe Theme includes a dozen ground and space-based missions in JPL's Astronomy and Physics directorate. He is also the Manager for the Navigator Program education and public outreach effort. Navigator missions include the Keck Interferometer, the Large Binocular Telescope Interferometer, the Space Interferometry Mission (SIM), and the Terrestrial Planet Finder (TPF). These missions are a part of NASA's Origins Theme and are all involved in the search for Earth-like planets orbiting other stars. Prior to JPL, Greene managed a Boston-based multi-media company which produced science and social history programs for PBS and engaged in wide-ranging education public outreach activities. Prior to his work in media and outreach, he worked as a management consultant for several years. He holds an A.B. in Economics from Harvard University and a master's degree in English from New York University.

Dr. Rolf Danner

Rolf Danner is the Outreach Scientist for the Navigator Program at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California. He is also the former director of JPL's Michelson Fellowship Program. He holds a Ph.D. in physics from the Technical University Munich. He was a graduate student in astronomy at the California Institute of Technology in Pasadena and at the Max-Planck Institute for Extraterrestrial Physics in Munich, Germany. He has taught astronomy at the University of Southern California, done postdoctoral research at Caltech, and worked in educational television programming. Rolf is a member of the American Astronomical Society and the National Organization of Gay and Lesbian Scientists and Technical Professionals.

Dr. Guy Worthey

Guy Worthey is mission scientist for Space Interferometry Mission in the role of Education and Public Outreach Scientist, an assistant professor of physics at Washington State University, and director of Project ASTRO Appaloosa, a teacher-scientist partnering effort in the inland northwest. Guy was born in Wyoming and graduated from the University of Wyoming in 1988 with a degree in astronomy. Guy obtained his Ph. D. in astronomy and astrophysics in 1992 at the University of California, Santa Cruz, then went on to spend 5 years at the University of Michigan, first as a lecturer within the astronomy department, then as a Hubble Postdoctoral Fellow. After 4 years as a professor at St. Ambrose University since 2001 he has made Washington State University his home.

Richard F. Alvidrez

Richard Alvidrez is the Educational Affairs Liaison for the Navigator Program. His responsibilities include developing and administering teacher-training programs, educator conferences, and education materials, and providing education support to JPL activities such as National Engineers Week, the Education Gateway for Education and Outreach programs, and other programs in JPL's interest. In 1997, he helped develop a program for 25 community colleges — the JPL Undergraduate Scholars (JPLUS) Program, the largest such program among NASA field centers. He has been involved in education for the past 25 years,

including teaching mathematics at the middle school, high school, community college, and university levels. He holds a BS degree in mechanical engineering from UC Santa Barbara, a BA degree in mathematics from California State University, Los Angeles, and an MS degree in education with an emphasis on instructional technology from the University of Southern California. For 12 years prior to his current position at JPL, he was Director of the Mathematics, Engineering, Science Achievement (MESA) program at California State University, Los Angeles, where he was responsible for encouraging students from historically underrepresented groups to enter math- and science- related fields of study, such as engineering. Alvidrez received the Hispanic National Achievement Award for Precollege Education in 1991.

Marni Berendsen

Marni Berendsen has been an amateur astronomer in northern California since childhood and is a former president of the Mount Diablo Astronomical Society (MDAS). She is currently working through the Astronomy Internet Masters program to earn a masters degree from the University of Western Sydney in Australia. She has been involved in education and public outreach for many years, developing and presenting astronomy events and workshops through the MDAS and through local schools, community groups, and science centers. In her previous 20-year career in software development, she has participated in and managed numerous software projects. Currently, she is the Education Project Coordinator with the Astronomical Society of the Pacific.

Dr. Stephen Gillam

Dr. Stephen Gillam is the Principle Investigator for the NSF-funded Consortium for Undergraduate Research Experience (CURE) site. He is a scientist based at the JPL Table Mountain Facility (TMF). CURE is based at JPL and California State Los Angeles (CSLA). He has been involved in CURE since it began in 1998 and contributed to three successful proposals to NSF and NASA that funded CURE from 1998 to 2002. Dr. Gillam has been a CURE Co-Investigator and was acting project director during the winter of 2000. He has mentored 22 CURE students since 1998, working on research projects that range from infrared imaging spectrometer verification to Doppler velocity measurements of the surface of Jupiter. He has a three-year volunteer adjunct professorship at CSLA where he periodically teaches classes in astronomical techniques to CURE students. In 1993 he mentored a SURF student, and in 2002 he mentored a USRP student. He has long-standing working relationships with teachers at several community colleges in the Los Angeles area. Dr. Gillam has worked in educational outreach since 1996 when he was part of the NASA-funded Physics Outreach Program based at CSLA and TMF. This evolved into the CURE REU site. His research interests include Globular Clusters and Extra-Solar planets.

Randal K. Jackson

Randal Jackson is Internet Architect for the Navigator Program. Before joining JPL, he was a Senior Editor for CNN.com, overseeing the network's award-winning online science and technology coverage. He was responsible for launching CNN.com/Space, a popular site devoted to space news and information. As a writer and editor, he has been involved in the coverage of such stories as the Pathfinder mission to Mars, the deorbiting of the Mir space station, and the construction of the International Space Station. Web sites he has written or produced for CNN include sections devoted to Mars exploration and the space shuttle. His print journalism experience spans a decade of work as a reporter and editor for community and daily newspapers in the Atlanta metro area. A lifelong devotee of space, his present focus is on the creative and innovative use of new media technologies to attract broad public participation in JPL's missions.

Rhonda Jones

Rhonda Jones is the Diversity Specialist for the Navigator Program. Her responsibilities include developing educational products, exhibits, and workshops for the formal and informal education communities. For the past five years, she has worked extensively with K-12 teachers, curriculum specialists, and outreach mentors to develop strong products and workshops. Her focus is on building quality products for NASA/JPL's majority and minority audiences. She works with several groups at JPL, including the Minority Education Office, the Diversity Office, JPL Affinity Groups, and human resources, and serves on working groups at NASA Headquarters to develop policy on reaching underserved audiences across the country. Ms. Jones also develops working relationships with many minority professional societies, Historically Black Colleges and Universities, Tribal Colleges, Hispanic Serving Institutions, and other minority institution on behalf of NASA and Navigator Public Engagement.

Jenny Tieu

Jenny Tieu is the Outreach Coordinator for the Navigator Program. Over the past several years, she has gained extensive experience working with several outreach initiatives at JPL, including helping lead an effort involved with Girls Inc. afterschool programs and coordinating activities for various regional library groups and associations. She has also worked to engage and support the science and engineering communities in Navigator-related events and conferences. She received her Bachelor of Arts in English with an emphasis in creative writing and journalism at the University of Southern California. Ms. Tieu leads Navigator's Girls in Science initiative, focusing on providing enrichment opportunities in science, math, and technology to young women around the country.

Vince Voong

Vince Voong is an academic part-time intern for the Navigator Public Engagement team. He recently earned his Bachelor of Science in Computer Information Systems from Cal State Los Angeles. Currently he is pursuing his second degree in Computer Animation. Vince's primary responsibilities include supporting the Navigator team through research and data gathering for multimedia modules, and through coordination support for team education and outreach initiatives.